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*ENVIRONMENTAL SERVICES*

WORKSHOP PROCEEDINGS

# TOXIC SEDIMENTS--APPROACHES TO MANAGEMENT

June 15 - 17, 1988

Prepared for

Sally Valdés-Cogliano
Science-Policy Integration Branch
Office of Policy Analysis
U.S. Environmental Protection Agency

EPA Contract 68-01-7489 to AMS, Inc.

September 1988

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The Science-Policy Integration Branch of the U.S. Environmental Protection Agency's (EPA) office of Policy Analysis (OPA) /Office of Policy, Planning and Evaluation (OPPE) sponsored a workshop on toxic sediment management held June 15-17, 1988 in Arlington, Virginia. The focus of the workshop was to develop a frame work for evaluating various management strategies aimed at reducing the risks posed by toxic materials in marine/estuarine riverine sediments. Areas specifically addressed included:(1)setting appropriate management priorities; (2)selecting best availabe management alternatives(s); and (3) implementing the chosen alternative. On day 1, participants were directed to better define the problem, refine questions that decision-makers should ask, and offer recommendations for improving the process. A series of case studies was presented (included in Appendix) that described the nature and extent of sediment problems and possible management solutions. On day 2, participants were divided into 3 workgroups (priority setting, option selection, option implementation) to develop the management framework. On day 3, results of the workgroup discussions were presented in a plennary session. Appendices include: lot of participants, case study summaries, overview of relevant laws/regulations, and overview of a National Academy Marine Board workshop on contaminated sediments.

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# WORKSHOP PROCEEDINGS:

# TOXIC SEDIMENTS--APPROACHES TO MANAGEMENT
JUNE 15 - 17, 1988

For

Sally Valdes-Cogliano
Science-Policy Integration Branch
Office of Policy Analysis
U.S. Environmental Protection Agency
401 M Street, SW (PM-220)
Washington, DC 20460

under EPA Contract No. 68-01-7489 to AMS, Inc.
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September 1988

# PREFACE

The Toxic Sediments--Approaches to Management Workshop focused on issues that need to be addressed when managing toxic sediments. Richard Morgenstern, Director of the Office of Policy Analysis, directed the participants to better define the problem, provide examples of the questions that need to be asked for informed decision-making, demonstrate approaches that work, and offer recommendations for improving the management process. A series of case studies was presented that described the nature and extent of sediment problems and the possible management options.

On the second day of the workshop, each participant was placed in one of three workgroups: setting priorities, selecting management options, and implementation. Some general results of these workgroups include:

- The importance of recognizing that the management of toxic sediments means management of a variety of activities, including issuance of disposal and discharge permits, selection of disposal methods and sites, site monitoring, enforcement, and cleanup
- The need for guidance on assessment methods
- The need for best management alternatives to consider a combination of institutional controls, source controls, navigational dredging where possible, and, where necessary, remedial action
- The need for waste management decision-making to, ideally, be integrated across possible disposal environments (land, water, air) to provide the least risk to human health and the environment
- The importance of communication at all steps of the management process with various involved parties [within the U.S. Environmental Protection Agency (EPA); among federal, state, and local agencies; with responsible parties; and with the affected public]
- The need to establish institutional mechanisms to facilitate interagency coordination.

Sally Valdes-Cogliano
Workshop Coordinator
Office of Policy Analysis

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* These three summaries were prepared as written case studies only and were not presented orally at the workshop.

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This report and background materials in the appendices were prepared by Mr. Barrick, Dr. Thomas Ginn, Mr. Pieter Booth, Dr. Lucinda Jacobs, and Dr. Chip Hogue of PTI. Workgroup and plenary sessions were attended and recorded by Mr. Barrick and Dr. Ginn of PTI, and Mr. Sabol and Ms. Cordelia Shea of AMS. Special recognition is deserved for the planning efforts and review of materials before, during, and after the June workshop by the workgroup leaders, Dr. Kim Devonald (Workgroup I), Mr. Keith Phillips (Workgroup II), and Mr. Howard Zar (Workgroup III).

# WORKSHOP ORGANIZATION AND OBJECTIVES

The Science-Policy Integration Branch of the Office of Policy Analysis (OPA) sponsored a two and one-half day workshop focusing on regional, state, and other federal agency experience in managing toxic sediments. These management activities have occurred under a variety of legislative and regulatory mandates related to sediments (see Appendix C). OPA's interest in toxic sediment management and an overview of expected workshop products are addressed in the following keynote presentation by Mr. Richard D. Morgenstern, Director of OPA.

Nine case studies summarized in Appendix B provided the framework for the workshop on the first day. The six studies selected for oral presentation (see **Overview of Case Study Presentations**) represent a range of toxic sediment problems in different environments. The studies illustrate how the problem became a priority issue, the management options considered and those selected, and the progress in implementing plans. Management of Superfund sites, regulation by permitting of dredging and disposal, and state management activities were highlighted in the presentations. The goal of the presentations was to provide a context within which recommendations on the best approaches to toxic sediment management could be developed.

On the second day of the workshop, the participants divided into three smaller workgroups. Their discussion focused on the following specific areas:

- Setting priorities for toxic sediment problems (facilitated by Dr. Kim Devonald, U.S. Environmental Protection Agency (EPA) Office of Marine and Estuarine Protection)

- Deciding on the best management alternatives (facilitated by Mr. Keith Phillips, State of Washington Department of Ecology, Sediment Management Unit)

- Implementing the chosen alternative (facilitated by Mr. Howard Zar, EPA Region 5).

On the final day of the workshop, each workgroup's results were summarized and presented in a plenary session of the participants, focusing on what could be learned from current practice and how the process of managing toxic sediments might be improved. The purpose of this report is to document the case studies and workgroup conclusions and recommendations. The proceedings conclude with an integrated synthesis of the workshop perspectives for managing toxic sediments. Lists of invited workshop participants and additional interested parties are provided in Appendix A.

## KEYNOTE ADDRESS

**Richard D. Morgenstern, Director**
**EPA Office of Policy Analysis**

I would like to welcome you to the OPA-sponsored Toxic Sediments--Approaches to Management Workshop. We have brought you here today because we hope to tap your experience and expertise to put together an examination of the "state-of-the-art" for the management of toxic sediments within the current regulatory environment.

In my remarks today I'd like to discuss both the importance of toxic sediments and what we hope to accomplish over the next two and one-half days. Before turning to the issue, however, I'd like to take this opportunity to introduce ourselves in the OPA and explain why we are interested in toxic sediments.

An important role of OPA is to identify emerging issues. We view contaminated sediments as falling into that category. Contaminated sediments have the potential to become a significant regulatory issue with important science implications. The agency's Unfinished Business Study, released last year, found in-place toxics to pose a high risk to the environment on both a local and regional scale. The Science-Policy Integration Branch of OPA--a mixture of ecologists and health scientists--decided to bring the issue of toxic sediment contamination to the forefront for a closer examination.

The overall goals of the Science-Policy Integration Branch in the OPA are to improve the credibility and consistency of risk analysis, to provide regulatory support to the Office of Policy, Planning and Evaluation (OPPE), and to coordinate science-policy issues.

We view toxic sediments as a potentially serious and costly environmental problem whose management may require participation and coordination of a wide range of players. We hope to assist in this process by providing a forum for discussion of toxic sediment management issues.

In a larger sense, why should anyone be concerned about toxic sediments? Most simply, we are concerned that they may not stay put and will continue to be a source of contamination to surface waters. As ecologists we are concerned about the risks to aquatic communities. As government managers we are concerned about the costs of cleanup, the risks of no action, and the potential for toxics in sediments to undercut the effectiveness of other programs.

Authority for management of toxic sediments can be found in a number of laws. Much of the current activity in the toxic sediments area is under the authority of three mandates: Superfund, the Marine Protection Research and Sanctuaries Act (MPRSA), and the Clean Water Act (CWA). Most of the case studies we will talk about today are in a Superfund or dredge disposal context. Looking to the future it will be interesting to see if the in-place pollutants being identified under various provisions of the CWA (e.g., nonpoint sources, surface water toxics, Great Lakes, clean lakes, and estuaries programs) will result in additional cleanup activities in toxic sediments.

How extensive and severe is toxic sediment contamination? It is difficult to quantify its extent and severity both because of large data gaps and because criteria for distinguishing between "clean" and "contaminated" sediments are still in the developmental stage. Still, considering the historical use of surface waters as dumping grounds, there may be hundreds of sites in the U.S. with toxic sediments of concern to environmental scientists and managers. Harbor areas, both freshwater and marine, generally have the most contaminated sediments due to wastes received from local urban and industrial sources, boat traffic, and rivers that feed into the harbors and drop their sediment load.

Although no comprehensive assessment of sediment contamination has been undertaken, there have been limited efforts to define the extent of toxic contamination. For example, a recent literature review and interviews with regional EPA offices identified and characterized 184 toxic hot spots. These sites included lakes, streams, estuaries, and ocean sites from every region of the country. Other relatively recent efforts to characterize the extent of contamination include the National Oceanic and Atmospheric Administration's (NOAA) national program to monitor toxic chemicals in bottom-feeding fish and sediments in 50 coastal sites and a U.S. Fish and Wildlife Service (FWS) report which cited contamination concerns in 85 refuges.

In summary, although the extent of contamination is not well-defined at present, it is likely to include a large number of hot spots.

When we do establish the presence of toxics in sediments, the next question may be: So what? What risks do they pose to the environment and human health?

Toxic sediments can adversely affect aquatic organisms and their predators. Sediments can be directly toxic. In addition, long-term exposure to toxics may result in reproductive failure, cancer, fin rot, or other diseases. It is easy to imagine that biomagnification of toxics may adversely affect fish-eating birds and mammals. A good example of this was when mink, fed Great Lakes fish, failed to reproduce. PCBs appeared to be the culprit.

How could toxics in the sediments affect us? A prime possibility is through the food chain--fish and shellfish could be contaminated. Many fisheries have been contaminated although the relative contributions from current pollution and sediments can be difficult to sort out. When recognized as contaminated, use restrictions (i.e., fishing bans) are a common risk reduction strategy.

The public health advisories that have been issued warning against eating fish or shellfish harvested within certain areas can be used as one measure of contamination of coastal waters. NOAA has been trying to centralize this information--preliminary results show that at least 40 public health advisories involving toxics have been issued by coastal states. Examples of waters with restrictions on harvesting include Baltimore Harbor, Maryland; the Inner New York Bight and most of Long Island Sound, New York; parts of San Francisco Bay and Santa Monica Bay, California; and the Hudson River. The health advisories are based on such contaminants as PCBs, mercury, DDT, chlordane, and dioxin. Advisories can reduce the human risks associated with toxic sediments. However, we may be writing off important fisheries in the process.

An advisory with no other action is an example of a management option. In what situations is this our best option? Is it our only option in areas that have been grossly contaminated over a number of years? Knowing that the costs of individual cleanup efforts are high, how do we set our priorities so we can make the greatest impact on improving water quality?

These are only a few of the questions we hope to address in the next few days. They are, as you know, difficult questions--which is why we need your help.

We hope that the case studies presented today will provide the subjects and framework for tomorrow's workgroup sessions. You will hear about several Superfund toxic sediment sites, dredged disposal management and regulation, and some state activities in toxic sediment management.

Tomorrow we can take what we've learned through this examination of case studies and apply it to the three workgroups:

- Establishing priorities
- Selecting a management option
- Implementation.

By the end of these two days we hope to have:

- Better defined what the problems are
- Provided good examples of the questions that need to be asked for informed decision-making
- Demonstrated approaches that work
- Offered recommendations for improving the managerial process.

In preparing for this workshop, we at OPA were struck by the need for greater communication and coordination on this issue. This sharing of experiences between offices in EPA, between regions and headquarters, between states and the federal governments, and among federal agencies is an important part of any effort to improve toxic sediment management. We are pleased to note that steps have already been taken to facilitate this need. A Sediment Oversight Committee has recently been organized by the Office of Water which includes members from several offices in EPA headquarters, regions, and laboratories. The committee will be meeting again at the end of June at the Duluth, Minnesota laboratory. Included on the agenda is the development of a near-term as well as a Waukegan 3- to 5-year operating plan to guide and coordinate sediment policy and activities agency-wide. This operating plan is expected to address issues such as overlapping authorities, regulatory authority, regulatory mechanisms, special regional concerns, and prioritizing sediment issues. It will also address technical issues such as EPA Office of Research and Development (ORD) priorities, methods for calculating sediment criteria, standardized and predictive bioassays, matching sediment evaluation method to a site, and the fate of contaminated sediments.

In addition, key activities will be identified that are to be reported to the administrator on a regular basis. As efforts to address contaminated sediments progress, other federal and stage agencies should be informed and involved.

I will be very interested in looking at the results of your efforts over the next few days. We have brought together a very able group of participants for this OPA workshop and expect its results will be beneficial to those in the regions and headquarters who make decisions on toxic sediment management. We appreciate the time you have taken to devote to this task. Thank you and good luck.

## OVERVIEW OF CASE STUDY PRESENTATIONS

A brief summary is provided in this section of the major points made during the presentations of case studies on the first day of the workshop. Formal papers were not submitted for these six presentations, but case study summaries are presented in Appendix B. Summaries are also provided in Appendix B for the Commencement Bay Nearshore/Tideflats Superfund project (the largest marine Superfund site), the Everett Harbor Navy Homeport dredging project in Washington (the deepest proposed disposal/-capping project in the U.S.), and the Oakland Harbor dredging project in northern California (the largest proposed dredging project to date in the U.S.).

### PCB CONTAMINATION IN THE UPPER HUDSON RIVER

Presenter: Clifford Rice, U.S. Fish and Wildlife Service
and PCB Settlement Advisory Committee

A detailed case study for this site has been prepared and given to the National Academy of Science Marine Board (Sanders 1988). Discharges of polychlorinated biphenyls (PCBs) from capacitor manufacturing plants operated by General Electric Company (GE) started in 1947 at Fort Edwards and in 1952 at Hudson Falls along the Upper Hudson River. Removal of a dam at Fort Edwards in 1973 resulted in downstream release of additional contaminated sediment as well as logging debris. Elevated levels of PCBs in Hudson River fish were first detected in 1969. By 1975, various fisheries were closed and administrative proceedings were begun to seek cessation of PCB discharges, penalties, and rehabilitation of the Upper Hudson River. A ban on the commercial striped bass fishery was later extended to include striped bass from Long Island Sound and the New York Bight (consumption of PCB-contaminated fish is the primary exposure route of concern).

An estimated 500,000 to 1,000,000 cubic yards of contaminated material has been released; approximately 80 percent of the total derives from one pipe. As the result of a settlement at which it was concluded that no laws had been broken, PCB discharges were ceased in July 1977, wastewater treatment facilities were constructed at the plants, and studies were undertaken to evaluate environmental effects and rehabilitation.

A PCB Settlement Advisory Committee oversees many of these studies under a $6 million fund. The committee is a panel of scientist, engineers, environmental activists, and public representatives working in cooperation with the New York State Department of Environmental Conservation.

Dredging-secured encapsulation is one alternative that is favored based on selection criteria emphasizing demonstrated technologies for which costs are not excessive. Alternatives for PCB removal and/or destruction from dredged sediments are still under evaluation. A continuing issue is the need to forestall further spread of PCBs into the lower reaches of the Hudson River. The more erodible sediments (PCB concentration approximately 20 ppm) are being addressed first rather than the highest concentration sediments (≥50 ppm in some areas). To date, several cleanup actions have been undertaken at Fort Edwards; rock riprap has been built along a portion of the Hudson River to prevent further scour, and monitoring of fish, river water, and sediments has continued.

Approximately 360,000 cubic yards of sediment has been removed and treated at a total unit cost of $110/cubic yard [dredging costs are estimated to be <10 percent of the total cost; the remainder is primarily because of the need for containment in a Resource Conservation and Recovery Act (RCRA)-type facility]. Approximately 10 percent of the total PCB in sediments will be dredged (i.e., approximately 51,000 pounds of PCBs). It was estimated that the dredging will produce a 20 percent reduction in fish tissue burden and the downstream transport of PCBs. Total requested budget for the project is $40 million (half federal funding; half state matching funds).

During the question period, the merits and rationale of the planned PCB reduction were debated. In addition, opportunities for removal of PCBs during navigation dredging were also discussed but site availability for the disposal of the dredged material is a key constraint. A number of additional responses during the question period have been integrated into the above summary.

## NEW BEDFORD HARBOR SUPERFUND SITE

**Presenter: Frank Ciavattieri, EPA Region 1**

A detailed case study for this site has been prepared and given to the National Academy of Science Marine Board (Ikalainen and Allen 1988). PCB contamination is the major concern although there is also some metals contamination (especially copper). The contamination has resulted in the closure of fisheries to varying degrees (approximately 5,000 acres are affected) and the idling of 200-300 fishing vessels. It is estimated that approximately 4-8 pounds/day of PCBs leave the upper estuary and enter the bay; 80 percent of the PCBs lie in two hot spots. The final study will rely on a hydrodynamic and sediment transport model, which is now being calibrated. The feasibility study is scheduled for completion at the end of 1988 and a Record of Decision is scheduled for the summer of 1989.

A risk assessment was conducted to quantify the potential risk to human health, to determine if remedial action will mitigate risks, and to serve as a baseline for evaluating effectiveness (and identify the need for cleanup). Direct contact, ingestion of sediment and biota, and air inhalation account for 99 percent of the potential exposure. Three distinct study areas and remedies have been established; the cleanup level will probably be limited by available technology. The primary alternative is removal of PCBs but treatment alternatives are not as promising as originally hoped. Potentially 1.5 million cubic yards of sediment could be removed at the site.

A pilot study has been scheduled to begin this fall in which dredging and disposal techniques studied in the laboratory will be demonstrated in the field. Tests will be conducted with three dredges (cutterhead, mudcat, and match box) and two kinds of disposal, including confined (diked on shoreline; treated effluent) and confined aquatic disposal (CAD) (burying of contaminated sediments below clean sediments that have been excavated). Special concerns for the pilot study include the wide variation in depth that will require modification of dredging techniques. Funds for demonstration projects are not limited to Superfund or even EPA-led sites but preference is given to sites on the EPA National Priorities List (NPL).

The overriding regulatory concern is attainment of Food and Drug Administration (FDA) limits for fish tissue concentrations of PCBs (5 ppm wet weight) and federal water quality criteria. Approximately $15-18 million has been spent to date. It is estimated that containment of sediments in the upper harbor could cost $20 million; dredging, removal, and treatment could cost up to $1 billion. A conservative estimate by NOAA of the cost of the fisheries closure is approximately $10-12 million for an estimated closure period of 50-100 years; the absolute catch value is approximately

$1 million/year. Development of the harbor has also been limited because no maintenance dredging has been permitted.

During questions, it was asked how priority funding was obtained for the project. New Bedford received funds because it is on the NPL (the Hudson River site in the previous case study is not) and the state declared the site a Number 1 priority for action (automatically elevating the site to the NPL). There was also discussion of the proposed revised Hazard Ranking System (HRS) in which food chain contamination will play a stronger role relative to human health concerns. It was noted that based on the original HRS, New Bedford did not make the initial ranking of NPL sites although there were identified problems. The increased emphasis on these environmental risks is expected to ease funding for marine sites. Responses to additional questions have been integrated into the above summary.

## WAUKEGAN HARBOR SUPERFUND SITE

**Presenter: Howard Zar, EPA Region 5**

Waukegan Harbor is a federal Superfund site located in Illinois. PCB contamination at Slip 3 of the site spans a concentration range of 500 to 10,000 ppm; cleanup at this site is expected to abate most of the problem in the harbor and Lake Michigan. In one localized area, PCB concentrations exceed 10,000 ppm. There is approximately 300,000 pounds of PCBs in 11,000 cubic yards of sediment in the harbor. An estimated 20-40 pounds/year of PCBs is discharged to Lake Michigan. This local discharge of PCBs from Waukegan Harbor is significant, although atmospheric deposition of PCBs from various sources is the largest lakewide contribution to Lake Michigan. Mr. Zar was only able to discuss a previous proposal embodied in a 1984 Record of Decision. The issue has been in litigation and negotiation since then, although current prospects for settlement are very good.

The alternatives previously selected for implementation include removal and disposal of highly contaminated sediment in Slip No. 3 and the Upper Harbor ($5.15 million); dredging, dewatering, and disposal of material in an adjacent parking lot ($10 million); removal and disposal of highly contaminated material in an adjacent ditch area ($0.74 million); containment and capping of the remaining material in the ditch area ($4.21 million); and containment and capping of material in the parking lot ($3.2 million).

The total cost of $23.3 million (most recently estimated at >$27 million) for the five cleanup actions has been evaluated in a feasibility study that considered 14 different cleanup processes. Treatment options evaluated incineration according to Toxic Substances Control Act (TSCA) requirements for landfill disposal. A problem in implementation is that the placement of dredged material behind a cofferdam will landlock a private ship operation, resulting in adverse public reaction.

Overall objectives of the 1984 plan were to: sequester or destroy >90 percent of PCBs in the harbor and remove >99 percent of PCBs when U.S. Army Corps of Engineers (Corps) navigation dredging is included; reduce the discharge of PCBs to a small percentage of the 20-40 pounds/year; and reduce the PCB level in fish to below the FDA action level. Based on transport and fish contaminant modelling, the product is expected to attain these level.

The site's legal history began in 1978 when EPA filed suit against the potentially responsible party [prior to the signing of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) in December 1980]. After EPA planned a federal cleanup action in January 1983, the 1978 suit was expanded. A record of decision was signed in May 1984 by Lee Thomas and EPA moved to dismiss the 1978 suit in June 1984. After dismissal of the suit in February 1985, EPA obtained a design access warrant which was blocked in March 1985 by a stay of warrant. Since April 1985, protracted legal proceedings were expected over the issue of site access; passage of the Superfund Amendments and Reauthorization Act (SARA) in 1986 provided authority for access. The issue is now under negotiation.

Questions asked in this session related to details of the remedial plan, especially concerning the significance of the PCB contribution relative to the overall Lake Michigan PCB budget and the no action alternative, treatment alternatives, and the food chain modeling predictions. Responses have been integrated into the above discussion.

## DREDGED MATERIAL DISPOSAL FOR THE PORTS OF NEW YORK AND NEW JERSEY

Presenter: Carol Coch, U.S. Army Corps of Engineers, New York District

A variety of operations and planning issues were discussed, including ocean dumping test criteria, types of dredged material to be disposed, the need for alternatives, navigation dredging, testing and siting criteria, and the overall decision process [including an interagency steering committee and 500-member Public Involvement Coordination Group (PICG); see the case study summary in Appendix B for additional details]. Major decisions follow the Corps/EPA management guidelines for dredged material. New York District has developed a regional manual that includes guidance based on indigenous organisms.

Most of the dredging is conducted by clam shell dredge; 6 million cubic yards are disposed annually (the equivalent of three World Trade Center towers). Approximately 90-95 percent meets unrestricted ocean dumping criteria and is disposed in two ocean sites located 6 miles east (Sandy Hook) and 12 miles south (Rockaway Inlet of the New York Harbor Transect). Primary laws concerning disposal include the National Environmental Protection Act (NEPA), CWA Sections 401 and 404, and Section 103 of the MPRSA of 1972 (as amended). Federal jurisdiction extends beyond the 3-mile limit; both federal and state agencies have jurisdiction within the 3-mile limit.

Three categories of material are designated:

I. Meets criteria for unrestricted disposal

   - Excluded from further testing (e.g., sand)

   - Fine-grained material (requires bioassay/bioaccumulation testing).

II. Meets criteria for restricted disposal (e.g., is remediated by capping with Category I material)

III. Does not meet criteria (not ocean disposed, but may meet upland disposal criteria).

The cost for the feasibility studies has been approximately $0.5 million/year over a 7-year period. The unit cost of ocean disposal is approximately $5/cubic yard.

The Mud Dump site was designated by EPA in June 1984 with a capacity of 100 million cubic yards (a new site will be needed by the mid-1990s). Alternative disposal options for large volumes of dredged material include upland disposal, use of dredged material as sanitary landfill cover, containment, subaqueous borrow pits, and continued ocean disposal. In special cases, beach nourishment, in-channel sand mining, and wetlands stabilization could be used for uncontaminated material, and containment areas could be used for small volumes of contaminated material.

During questions, it was noted that most of the problems in deciding appropriate disposal options occurred with Category II material. In response to a question concerning the sensitivity of the bioassay tests that were used, it was noted that the bioassays were refined for use in New York Harbor. The testing is constantly being revised to reflect environmental changes.

## DEVELOPMENT OF SEDIMENT MANAGEMENT PLANS IN PUGET SOUND

Presenter: Catherine Krueger, EPA Region 10

Sediment planning efforts in Puget Sound involve multiple federal and state agencies, including the Washington Departments of Ecology (Ecology) and Natural Resources, the Corps (Seattle District), and EPA (Region 10). A large amount of sediment is deposited in deep basins that extend to 900 feet; it is estimated that approximately 80 percent of the contaminants discharged to Puget Sound remain within the main basin as a result of recirculation and deposition. Contaminants eventually bind to sediment particles and settle to the bottom of the sound. Little is known concerning specific cause/effect relationships, but concerns over toxics contamination and observed biological effects in the late 1970s and the 1980s eventually led to the establishment of a sound-wide management plan by the Puget Sound Water Quality Authority (Authority) in 1987. The plan balances long-term solutions with near-term needs for environmental controls. As a matter of policy, association of biological effects and chemical contamination have been accepted as a means of identifying problem sources of chemicals. The presence of contaminants is not the critical aspect; biological effects are.

At the industrialized Commencement Bay Superfund site, 25 major sources and 400 potential sources have been evaluated. Cleanup levels that are considered environmentally protective for sediments have been proposed for the Superfund site based on biological effects relationships established for 71 chemicals. Estimated cleanup costs range from $24 million to $64 million, and result from a remedial investigation/feasibility study (RI/FS) that cost approximately $3 million.

In assessing procedures for evaluating navigation dredging projects, the Puget Sound Dredged Disposal Analysis (PSDDA) accomplished the following three objectives: (1) determine "how clean is clean" for open-water, unconfined disposal sites; (2) develop test procedures; and (3) evaluate costs of different alternatives for disposal site management relative to the impact of different volumes of dredged material. It was decided that minor adverse effects (i.e., sublethal effects onsite; no effects offsite) was an unacceptable goal for disposal sites, in part because physical impacts routinely occur during operation of these sites.

The Urban Bay Toxics Action Program, a major component of the Puget Sound Estuary Program (PSEP), was initiated in 1984 by EPA's Office of Puget Sound and Ecology. Substantial participation has also been provided by the Authority and other state agencies, and local government. Action programs for individual bays consist of the identification of problem areas in urban bays (problem definition predominantly based on sediment contamination), identification of potential sources, development of an Action Plan for source control, and formation of an Action Team for plan implementation (including permitting, inspections, and enforcement activities). Actions to date have focused on Elliott Bay, Everett Harbor, and Budd Inlet adjacent to the cities of Seattle, Everett, and Olympia, respectively. Source control actions are well underway as the focus of the action programs. Sediment remediation has not been undertaken at any of the sites.

In response to the Authority's 1987 management plan, Ecology is currently developing state sediment quality standards for use in preventing sediment contamination and identifying and designating sediments that have adverse effects on biological resources or correspond to significant health risks to humans. The standards shall be used by Ecology to identify sites with sediment contamination, and as a basis for limiting industrial and municipal discharges that cause sediment contamination in excess of the standards. Separate regulations and guidelines are also being developed for limiting point and nonpoint sources, prioritizing and conducting sediment remedial actions, and identifying sediments that are acceptable for disposal in water or on land.

During questions, a representative of the Corps commented that the empirical sediment quality values approach applied in Puget Sound was good for identifying problem sites for remediation, but that there were questions concerning the applicability of chemical predictions of biological effects at disposal sites based on analyses of material to be dredged (i.e., because a cause-effect link had not been established for disposal site effects). In addition, state testing requirements that might be more rigorous than federal guidelines could result in the State paying the differential testing cost for federal dredging projects. Finally, the representative felt that some of the tests recommended in Puget Sound were unacceptable (e.g., oyster larvae bioassay) for the Corps' Section 404 assessment under the CWA because they were applications of water column tests to sediments. From a federal viewpoint, the participant believed that the standard bioassays (e.g., using adult organisms) met the intent of Section 404.

In response, it was noted that specific cause-effect links were not needed to use biological predictions in risk management of disposal sites; that the decision on testing requirements was delegated to the states; and that the Corps Seattle District had accepted the bioassay tests as modified for sediments (the concern was at the national Corps level). It was also noted that some of the tests typically used by the Corps had been determined to be insensitive, and that although some of the more sensitive bioassays may be considered experimental elsewhere, they are routinely applied in Puget Sound and are generally accepted. It was agreed that the standard Corps bioassays met the intent of Section 404, but that Section 401 certification under the CWA was a separate issue to be decided by the State with concurrence by EPA.

### SULLIVAN'S LEDGE SUPERFUND SITE

Presenter: Jane Downing, EPA Region 1

Sullivan's Ledge in New Bedford, Massachusetts, is an active golf course in a wetlands environment. PCB contamination is the primary concern, and concentrations in soil samples range from undetected to over 2,000 ppm. Two areas contain concentrations in excess of 100 ppm. Other soil contaminants include lead (>4,600 ppm in one area) and polynuclear aromatic hydrocarbons. Chief risks related to soil contamination are associated with accidental ingestion of the surface soils, and erosion, which results in the deposition of PCB-contaminated sediments in adjacent water bodies. There appear to be minimal risks to public health associated with this sediment contamination but there are potential risks to terrestrial and aquatic life.

Site-specific sediment quality criteria have been applied at Sullivan's Ledge based on guidance provided by EPA's Office of Criteria and Standards (the criteria are based on water quality assessments for freshwater organisms integrated with equilibrium partitioning theory for nonpolar organic compounds in sediment). Bioaccumulation results have been evaluated relative to FDA action levels. An evaluation of remediation vs. no-action alternatives considered NOAA concerns about possible impacts to the Paskamansett River, the magnitude of sediment contaminant levels, compliance with federal and state applicable or relevant and appropriate requirements (ARAR), disruption of golf course activities, significant adverse impacts to wetlands, and a cost/benefit analysis. Remedial alternatives included containment; *in situ* biological treatment; removal and disposal of sediments; removal, solidification, and disposal of sediments; and onsite incineration. The cost of remediation is estimated at $4 million for capping sediments; $10-20 million for pumping and treating groundwater; and <$1 million for excavating and solidifying selected sediments (there are additional costs of site restoration).

The final alternative will follow CERCLA/SARA guidance, which requires the selection of a remedy that ensures the protection of public health and environment, complies with federal and state ARARs, applies cost effectiveness as one of several selection criteria, focuses on treatment to attain a permanent remedy if possible, and provides the best balance across all evaluation criteria. Some of the alternatives will provide complete remediation, while others mitigate the problem.

During the question period, there was some concern as to why there was public usage of the site prior to remediation. There was additional clarification concerning the application of sediment criteria based on freshwater quality standards. It was noted that the use of the criteria at the site was intended as a yardstick for problem identification; not necessarily for deciding remedial actions. Because the PCB bioaccumulation criteria were linked to an FDA action level (set in part by economic factors) it was also questioned whether an environmentally protective decision for wetlands could be made. An alternative criterion related to magnitude of potential chronic effects of PCBs may be used.

# MANAGEMENT PERSPECTIVES ON CONTAMINATED MARINE SEDIMENTS

**Kenneth S. Kamlet, Chairman**
**Marine Board Committee on Contaminated Sediments**
**National Research Council**

On the second day of the workshop, a plenary session was held to hear comments from Dr. Kenneth Kamlet, who presided over the National Research Council's 1988 workshop on "Strategies and Technologies for Cleaning Up and Managing Contaminated Marine Sediments." The charge of the Marine Board, scope of the Board's contaminated sediment project, and Board membership as summarized by Dr. Kamlet are presented in Appendix D. Dr. Kamlet also presented a comparison of the Marine Board and OPA workshops (Table 1); the former focused primarily on technical issues and the latter focused on policy and management issues. The following comments were presented as a summary of issues and observations concerning the three areas of emphasis at the OPA workshop: setting priorities for management, selecting the best management alternatives, and implementing the preferred alternative.

Observations for setting priorities for management included:

1. Estimation of human health and ecological risks is a matter which, in the Superfund context, will theoretically occur under an improved HRS.

2. From a remediation standpoint, the most important factors are likely to be technical and cost feasibility, natural recovery estimates, and ability to distinguish and/or control sources.

3. A "how clean is clean" standard is clearly needed, if not for setting priorities, at least for defining cleanup targets.

4. A unique attribute of underwater sites is that the need for navigational dredging may become a major driving force for sediment excavation. In such

## TABLE 1. COMPARISON OF MARINE BOARD (5/31 - 6/3) AND OPA (6/15 - 6/17) WORKSHOPS

**Parallel Elements**

| Marine Board Workshop | OPA Workshop |
|---|---|
| Extent of Contamination (EPA & NOAA programs) | |
| Classification of Contaminated Sediments | Setting Priorities (Workgroup I) |
| Significance of Contamination (benthic biota, human health) | Setting Priorities |
| Mobilization and Resuspension | |
| Assessment and Selection of Remedial Technologies | Selecting the Best Management Alternative(s) |
| | Implementing the Selected Alternative(s) |
| Case Studies | Case Studies |
| New Bedford Harbor, MA | New Bedford Harbor, Ma |
| Hudson River, NY | Hudson River, NY |
| James River, VA | |
| Commencement Bay, WA | Commencement Bay Nearshore/ Tideflats |
| | Puget Sound Sediment Management |
| Everett Harbor Dredging Project | Everett Harbor Dredging Project |
| | New York Harbor Dredged Material Mgmt. Plan |
| | Waukegan Harbor Superfund Site |
| | Sullivan's Ledge Superfund Site |
| | Port of Oakland Dredging Project |
| Workgroups | Workgroups |

cases, there could be advantages to utilizing CWA Section 115 authorities (if funded), in conjunction with Section 10/404 dredging authorities, in preference to CERCLA/SARA authorities.

Observations on selecting alternatives included:

1. Short-term risks associated with sediment removal can be minimized by use of specially designed dredges, which are readily available overseas. There are a variety of institutional issues (e.g., Jones Act restrictions on use of foreign-hulled vessels for dredging) which may complicate but should not totally prevent availability of this equipment in the U.S. U.S. suppliers of dredging equipment could provide such equipment in the U.S., if there were confidence that a sufficient market exists here for this equipment.

2. Among the factors which make "no action" the alternative of choice, "adverse impacts of remediation" and "institutional constraints" should not be major constraints [except where intervention would cause unacceptable habitat damage (e.g., to wetlands) wholly apart from any potential for sediment resuspension]. Important considerations include not only "high remediation costs" and "low mobility of toxics", but also "rapid covering" over of contaminated sediments (by natural deposition), and very "high mobility of toxics" (or contaminated sediments).

3. In-place containment or treatment: a potentially significant legal and policy issue is whether capping with clean sediments is to be deemed a preferred "treatment" approach under SARA Section 121(b). On the one hand, capping can be performed onsite (which is favored over offsite transport) and it can "permanently and significantly reduce the ... mobility of the hazardous substances, pollutants, and contaminants" present. On the other hand, it is not treatment in the usual chemical, biological, or physical sense.

4. The most obvious difference in risks associated with upland and aquatic disposal of contaminated sediments is the greater significance of food chain contamination as an exposure pathway with aquatic disposal, and greater concerns regarding leaching of contaminants into groundwater and/or volatilization into the air with upland disposal.

Observations on selecting alternatives included:

1. Legislative or regulatory constraints: lack of HRS coverage of food chain pathway (being rectified); lack of "how clean is clean" standards (sediment quality criteria will partially fill this void); status of capping as preferred remedial technology; lack of funding for CWA Section 115 "in place" pollutants authority; need for more explicit consideration of when rapid "removal" action is required to address contaminated sediment problems.

2. Public perception of risks has, in at least several cases, blocked or delayed implementation of remedial action involving excavation and upland disposal or treatment of contaminated sediments. While a shift from underwater to upland may be toxicologically and physico-chemically inappropriate where the primary sediment contaminants are heavy metals (the mobility of which could be increased by the shift in redox potential associated with exposure to air), it probably makes sense in many cases where the primary contaminants are toxic organics (provided precautions are taken to limit volatilization).

3. Remedial action projects involving contaminated bottom sediments often consume inordinate time and money in seeking to characterize and prioritize the problems and in evaluating potential alternatives. While this may be acceptable and justifiable for sites involving large aerial extents of contamination (e.g., Commencement Bay, New Bedford Harbor, Upper Hudson PCBs), it clearly cannot be sustained on a routine basis or for smaller-scale sites (e.g., Waukegan Harbor, Sullivan's Ledge). Completion of HRS revisions and sediment quality criteria (and/or other "how clean is clean" standards) should help matters considerably.

4. Opportunities to piggyback navigational projects may not be widespread but are certainly significant. Navigational maintenance dredging, by definition, occurs in areas of significant net sediment deposition. These areas therefore often coincide with hot spots or sediment contamination.

In summary, Dr. Kamlet concluded that although the OPA and Marine Board projects have much in common, they differ in primary orientation. The Marine Board project is principally geared to enabling decisionmakers to better select appropriate remedial technologies. The OPA project seems primarily designed to identify policy issues and to provide broader management recommendations.

Each study would doubtless benefit from contributions from the other. It is suggested that each group be afforded the opportunity to review and comment on a draft version of the report generated by the other. (The Marine Board Committee has met again August 3-5, with a final report to be issued by the end of the calender year).

## WORKGROUP CONCLUSIONS AND RECOMMENDATIONS

Three workgroups met on the second day of the workshop to discuss specific issues related to toxic sediment management. The following sections describe the focus of each workgroup and present workgroup summaries. The discussion of conclusions and recommendations is organized according to a list of questions addressed by each group. Comments directed to workgroup leaders by participants during summary presentations at the final plenary session of the workshop have been integrated into each section. A list of major unresolved issues is presented in a following section (**Considerations for Integrating Toxic Sediment Management Strategies**).

Prior to the workshop, the workgroup leaders met and agreed that, where appropriate, navigation dredging issues should be distinguished from sediment cleanup issues. Although navigation dredging may involve removal of contaminated sediments, the procedures used to determine priorities, best management alternatives, and implementation strategies in navigation projects differ from those for projects focused on remedial actions. In navigation dredging, the primary objective is to make a channel possible while minimizing adverse environmental impacts. Consideration of any ancillary ecological improvements due to removal of contaminated sediments is not appropriate under the law in setting priorities for federal dredging projects. Potential ecological impacts of dredged material disposal must be assessed under the CWA and MPRSA. By contrast, the objective of cleanup projects (e.g., Superfund) is control of ecological and health risks, and dredging is one alternative that may be used to accomplish this objective. To the extent appropriate, the workgroup leaders agreed to separate these types of projects during discussion.

## WORKGROUP I - SETTING PRIORITIES FOR TOXIC SEDIMENT MANAGEMENT

Management of toxic sediments requires government agencies to perform or oversee a variety of activities, including:

- Issuing disposal and discharge permits
- Selecting disposal sites for dredged materials

- Monitoring disposal sites

- Cleaning up contaminated sites where navigational dredging is not required

- Enforcing applicable regulations and permit conditions.

Priorities must be established for each of these activities. Participants in Workgroup I discussed the management options available for performing these activities and identified ways to establish management priorities. The workgroup discussions addressed four groups of questions, and a summary of each is presented below. For each question, participants described their experiences with previous projects and highlighted unresolved issues. When appropriate, decision-making processes pertinent to navigation dredging projects and those for cleanup projects not involving navigational dredging needs are summarized separately. Workgroup I also explored issues associated with determining "how clean is clean", how to compare sites and problems, and the need to facilitate communication channels. Discussion of these topics is summarized in separate sections following options for setting priorities.

### Options for Setting Priorities

*What options are there for establishing sediment management priorities? How are priorities established for such management activities as permitting, disposal site selection, monitoring, enforcement, and cleanup?*

**Permits**--Two basic types of permits are issued relevant to sediment management: permits for disposal of dredged material, and National Pollutant Discharge Elimination System (NPDES) permits for protection of surface water quality.

The Corps is responsible for navigation dredging permits under the CWA and MPRSA. CWA authority applies to dredged material disposal in inland waters, including estuaries. MPRSA authority applies to disposal in the ocean. Permits are issued on a case-by-case basis. Decision-making depends on sediment toxicity, the physical composition of the material, and available disposal options. Nationally, EPA and the Corps have historically interpreted laws to mean disposal can occur if environmental conditions are not further degraded by the action. A contaminated site does not require improvement, only maintenance of the status quo. Material deemed toxic cannot be disposed of in open waters but must be disposed of in a containment area or secure upland disposal area. Disposal sites for nontoxic material must correspond sufficiently in physical characteristics (e.g., grain size) to the material to be disposed that ecological damage will not occur. The Corps employs a cost/benefit analysis to determine when a permit should be granted. For Corps dredging projects, projects are ranked according to their tonnage of dredged material. On non-federal dredging projects, the benefit to the public must be assessed and factored into the permit decision.

Several problem areas were mentioned in relation to navigation dredge permits and differences among laws and the implementation of those laws. EPA Regions and Corps Districts often use different procedures and priorities in processing and reviewing permit applications. [That is, EPA Regions may differ from one another and Corps Districts from one another. Typically, an EPA Region uses methods consistent with its Corps District.] Workgroup participants felt there is a major need to establish more consistency, and noted recent efforts to accomplish this. Problems also occur when states enact more strict regulations or guidelines than their federal counterparts. The additional costs required to maintain more than just federal nondegradation standards will typically be decided by states during negotiations with responsible parties. The Corps expressed concern with continuing federally sponsored dredging projects where state laws are too rigorous and dredged material testing costs too high. Greater consistency among regulations (e.g., MPRSA Section 103 and CWA Section 404) was also desired by the workgroup.

Currently, NPDES permits focus on water column impacts and do not usually consider sediment quality. EPA Region 10 is in the process of revising its NPDES permitting process to incorporate sediment quality objectives. Priority has been given to dischargers that release specific chemicals of concern. Region 10 is incorporating more effects-based measures (e.g., empirically derived, toxicity-based sediment quality values, fish pathology, and other biomonitoring) into the permit process. Statistically significant differences between disposal sites and nonurban reference environments removed from the direct influence of contaminant discharges (i.e., relatively pristine environments) will be used as part of the process to determine permit compliance. Region 10 is trying to place the burden of demonstrating no-effects on dischargers.

Puget Sound agencies are still considering "impact zone permitting" where higher levels of contamination would be permitted in distinct and concentric concentration zones around an outfall. Management or enforcement actions are triggered when sediment contaminant concentrations exceed specified zone limits. Problems encountered with this approach have included uncertainty as to who pays for cleanup activities involving these sediments (for example, the discharger or a navigation dredging proponent), and the lack of monitoring and cleanup technologies.

Region 10 and the state of Washington are also working in concert to establish particle-based standards for effluents. Problems encountered during this process include the establishment of "concern" limits and the linkage of such limits to control/management measures in cases of single discharges, and in cases of multiple dischargers. The composition of chemicals in sediments and discharged particulate material provides a means to trace pollutants to the responsible discharger.

One concern mentioned by workgroup participants was the issue of permits in areas of multiple dischargers. The waste load allocation process is especially difficult to design when sediments are the contaminant sink. In these situations, it is frequently difficult to identify the discharges primarily responsible for creating a problem. The Superfund approach to this problem in some Regions has been the payment by each discharger for a portion of cleanup/management costs. Effluent monitoring may also be used to prove that individual dischargers are not responsible for impacts associated with specific known chemicals. However, in general it was agreed that better methods of identifying the "footprints" of individual dischargers (by analyzing suites of individual chemicals) would contribute to the ability to control toxic impacts through discharge permits. During related discussion by Workgroup II in the final plenary session, a participant from one of the state sediment management programs noted that the ultimate ability to link sediment contamination and discharge controls is subject to the following assumptions, limitations, and concerns:

- It is assumed that sediment criteria eventually can be related to effluent particulate limits (that is, the scientific understanding of transport and fate processes can be adequately developed)

- Notwithstanding effluent limits, the best source control available at present will probably continue to result in deposition of contaminated sediments

- Given continued deposition of contaminated material, a dilution zone or bottom impact zone for sediments near discharges might be needed to address sediment quality in permits

- Given the possibility that impact zones may be defined, some form of "closure plan" to be implemented when a discharge ceases (e.g., analogous to RCRA closure plans for contaminated facilities) might be needed as part of sediment maintenance; a difficulty arises in applying such a plan in multiuser environments (the alternative is to phase liability or phase cleanup such that discharges can be continued at a determined price)

- Dredging in port maintenance areas has the important associated issue of whether the port has to pay the increased cost of, for example, a municipal storm water discharge that is permitted; procedures for recovering these costs may be needed to resolve this concern.

In addition to concerns about multiple dischargers, Workgroup I also noted that assessments by the EPA Office of Toxic Substances (and others) sometimes do not address the potential for sediment contamination posed by new chemicals.

**Disposal Site Selection**--The New York District of the Corps, which is a cooperative agency with Region 2, is using a geographic information system (GIS) in conjunction with a modified zone of siting feasibility (ZSF) approach to select contaminated sediment disposal sites. The following factors are used to evaluate sites:

- Site physical descriptions (e.g., bathymetry, topography, prevailing currents and channels, temperature and chemical regime)

- Location of biota (both pelagic and benthic) relative to proposed dump site

- Economic cost and impact on port activities
- Site surveys for potentially impacted human activities (e.g., mining, fishing, archaeologic sites)
- Sediment contaminants present
- Legal requirements (Section 404 of the CWA and Section 103 of the MPRSA)
- International treaties (in open ocean disposal).

Some states have questioned whether contaminated dredged material should be considered hazardous and be handled under the provisions of RCRA. The Corps concurs that dredged material should be handled according to case-by-case decisions made at the state level. States require toxicity testing because they have jurisdiction over upland disposal, but there is no agreement at the federal level that RCRA should be involved. Some participants felt that it is not technically justifiable and cost-effective to always take all steps required under RCRA (e.g, why put a landfill liner in a non-permeable sediment disposal site?).

**Post-Disposal Monitoring**--Workshop participants agreed that post-disposal monitoring is important in determining the effect of disposal and discharge activities. The Corps noted that the majority of disposal sites where problems arise are those that have not been monitored. Monitoring is expensive, and cost is clearly the reason that optimal amounts of monitoring are not conducted.

Decisions whether to monitor after disposal in open water depend on costs, the dispersive nature of the site, water depth, and type of contamination present in the sediments. In making monitoring decisions, EPA Region 1 also evaluates the number of facilities discharging to an area, the size of the receiving body, and flushing rates. Screening Level Concentrations, which are effects-based, chemical-specific thresholds developed from historical data sets by EPA headquarters, are used as screening for concern levels. As a regulatory tool, CWA Section 308 letters have also been sent to dischargers when there are many dischargers or when flushing rates are too low (Section 308 governs inspections, monitoring, and entry at permitted facilities and dischargers).

The type and frequency of monitoring depend on various management and technical factors:

- Disposal management technique (e.g, capping)
- Management mission
- The contaminant of concern (e.g., PCBs)
- Biota present
- Physical characteristics of the site
- Expected rate of contaminant change or site degradation
- Potential for human impacts
- Costs.

Monitoring benthic infauna, although desirable at almost every site, is difficult because of the associated high cost. Tiered monitoring programs can be used, however, to incorporate benthic monitoring when other less costly analyses indicate that the additional analyses and costs are justified. Regional Superfund programs are interested in using bioassay methods as the second tier of a tiered approach. Many workgroup members expressed a desire for the development of general guidance on the types of testing possible and protocols for tests, including benthic and bioassay analyses. Participants concluded, however, that such guidance should not limit available management options. Resource managers want to be told what they **can** use and not what they **must** use.

Funding for monitoring comes from various sources. Initial costs may be borne by the project proponent and/or federal or state agencies. States often choose to continue monitoring programs after federal cutoff of funds. The Corps may incorporate monitoring costs as part of its cost-benefit analysis.

**Enforcement**--Most enforcement of dredging permits is triggered by inspections conducted by the Corps, U.S. Coast Guard, or EPA. Enforcement actions may be caused by three types of violation: disposal of nonpermitted material, disposal of permitted material in the wrong locations, and disposal without a permit. Enforcement may also be triggered by reports from the public or environmental groups. In establishing priorities for enforcement actions, the Corps considers the volume of the material and level of contamination, if any. Decisions regarding court action are generally dependent on the willingness of the dredger to comply with permit requirements.

Under NPDES permits for discharges to Puget Sound, sediment contaminant levels trigger intensive inspection in areas of potential discharges. Sometimes permit violations are identified during these inspections. Although monetary penalties can be assessed for these violations, they are used only as a last resort. Most frequently, a special action team of enforcement and compliance personnel from EPA and Washington state agencies advises the discharger in an effort to bring the discharge into permit compliance.

**Cleanup**--Remedial actions may include dredging, capping, ceasing discharge or disposal and allowing natural recovery (no sediment action), and onsite chemical treatment. Priorities for cleanup actions can be established in a variety of ways. The federal HRS, for example, is used by the Superfund program to establish priorities for placing sites on the NPL. Studies to determine the precise extent of the problem and to develop cleanup options are then conducted under a remedial action/feasibility study for each site. Each state may nominate one site to the NPL without reference to the HRS (e.g., the New Bedford Superfund site was a state nomination that did not score sufficiently high on HRS). The HRS system currently used is heavily influenced by potential adverse human health effects (e.g., through drinking water or food chain contamination). The system is currently under revision and will ultimately weigh ecological effects more heavily than in the past.

High levels of contaminants in fish or groundwater aquifers have also triggered cleanup programs. In the Hudson River, for example, high levels of PCBs in fish and sediments caused concern that led to further actions. High levels of volatile organic compounds in groundwater adjacent to one Commencement Bay site, followed by additional studies in the waterway, triggered a decision to recommend cleanup in conjunction with a groundwater pump and treat plan.

Routine monitoring may indicate that cleanup actions are appropriate. For example, the wastewater treatment plant operated by the Municipality of Metropolitan Seattle (Metro) in Puget Sound is required to monitor effluents of selected combined sewer overflows as part of the NPDES permit. In general, the municipality would pay for monitoring, and when a problem is found, would pay for capping of sediments. This program is a continuation of periodic monitoring conducted on a voluntary basis by Metro in the past. At one major combined sewer overflow (CSO) location, Metro initiated a plan for capping sediments to mitigate contamination resulting from past discharges and to discriminate effects of ongoing discharges.

Cleanup may also be an objective of a special study or local program. In the Puget Sound Estuary Program (PSEP), sediment cleanup, either through source control and natural recovery or direct remedial action, is one of the program objectives for individual urban bay toxics action plans. Storm drain cleanup efforts have been initiated because of high levels of contaminants of concern in sediments next to storm drain discharges. Funding is provided in part by the CWA. This assistance, coupled with general public interest and state and local government participation, has proved to be key in implementation of the Puget Sound program.

Legal mandates and funding set aside specifically for sediment management have also triggered cleanups. CWA Section 115 set aside money and provided the authority to perform hot spot cleanup demonstrations. Under the Rivers and Harbors Act of 1970, the Corps also built confined disposal facilities in the Great Lakes as 10-year demonstration projects. The initial $8-15 million for this demonstration was used quickly, but the legal authority for cleanup still exists under CWA Section 115. This authority may provide justification for future cleanup operations.

The priority for cleanup actions may also be influenced by the availability of disposal sites. If suitable sites are not available, then alternatives to removal will have a high priority. A separate issue for prioritizing cleanup actions involves economic feasibility, which the workgroup identified as an important issue to consider early in the analysis of a site. Currently under Superfund, risk assessment and risk management are separate exercises. Sites are identified for the NPL without cost estimates. Remedial measures, alternatives, and associated costs are then identified. Cost/benefit analysis is performed last. There was concern by some participants that the cost of funding projects may jeopardize Superfund itself. Some people recommended that Superfund not pay for cleanup until enforcement efforts have been exhausted. However, this concern was beyond the scope of the workgroup and was not discussed in depth.

## How Clean is Clean?

*What factors should be considered when setting priorities and determining "how clean is clean"?*

A fundamental question in the management of sediments is what constitutes an acceptable level of contamination, i.e., how clean should sediments be? In the case of navigational dredging, effects-based measures of sediment contamination (e.g., bioassays) are required under the CWA. At state request in two states, the Corps uses an extraction procedure toxicity test to compare contamination to various standards for land disposal evaluations under RCRA. Under ocean dumping regulations, bioassays and bioaccumulation testing are needed if there is reason to believe sediments may be contaminated.

The workgroup expressed concern as to whether current dredged material bioassays from the EPA/Corps "implementation manual" for ocean disposal are protective enough. The sensitivity of some of the bioassays selected from the list of permissable tests may be insufficient. It was noted that the methods are currently under revision to address this concern.

It was observed that current state-of-the-art detection levels may be driving concern levels for certain chemicals, since no other criteria exist. Scientific justification rather than instrument limitations should drive concern levels. In some cases routine detection levels of chemicals are higher than the actual concern levels; concentrations at which some substances become dangerous can be well below current routine detection limits.

Many chemical data are currently collected but are not used in regulatory decisions because no criteria exist to evaluate them. Some participants noted that data collection by itself is perceived by the public as indicating that some beneficial action is being taken. The workgroup agreed that this is not an appropriate way to show the public that agencies are actively working to correct environmental problems.

Workshop participants agreed that information on sediment chemistry is an important factor in setting remedial action cleanup levels. It was noted that documentation of human and ecological impacts or risks is also important before cleanup options are considered. Advantages associated with the use of sediment chemistry data include the utility of these numbers in setting target cleanup values and the wide availability of chemistry data from studies defining the areal extent of contaminated areas. Sediment chemistry can also be used to link the presence of toxic chemicals with their sources. In addition, the use of chemical data has historically been legally defensible. Disadvantages of chemical criteria for cleanup include uncertainties in the science underlying criteria development (i.e., prediction of biological effects). Another disadvantage is that chemical criteria developed specifically for individual chemicals do not consider mixtures. Further, no criteria exist for some chemicals, and other chemicals may be unmeasured.

There was no clear consensus as to the most effective way to collect chemical data (i.e., analyze samples for only specific chemicals of concern, or by "wide sweeps" to look for all chemicals present, for example priority pollutant scans or even broader scans). The Puget Sound program in Region 10 measures concentrations of at least 61 chemicals of concern that have been historically associated with sediment toxicity, bioaccumulation, human health effects, or degradation products. The EPA Office of Water is also developing sediment quality criteria that are based on existing water quality criteria, and that include a correction factor for modifying factors such as sediment organic content. Such sediment quality criteria can be used to trigger management action once criteria are exceeded. It was noted that EPA/ORD is evaluating the additional question of whether such standards might be applicable to organisms that ingest sediments. There was also concern expressed during the final plenary session that guidelines for remedial action or dredging be disseminated in such a way that they do not automatically become ARARs that constrain options at CERCLA/SARA sites.

The workgroup participants recommended that chemical measures be used for comparing and prioritizing sites, but that for cleanup determinations, effects-based measures should also be included. It was suggested that "triad" approaches incorporating sediment chemistry, bioassays, and *in situ* biological measurements (e.g., fish disease, benthic community measures, bioaccumulation, and other observations) (see Long and Chapman 1985) were useful in evaluating the extent of contamination or degree of cleanup required. Analyses of benthic infauna were recommended when adequate funding was available, but it was also noted that observed effects could be due to factors other than toxic sediments (hence the need for appropriate reference conditions).

The precise determination of "how clean is clean" should in part be determined by the target and goals of individual projects. The use of tiered testing strategies was recommended by the workgroup as a desirable way to approach this determination. The first tier would be individual chemical criteria, and the second tier would be a relatively simple biological measure(s) such as a bioassay and/or a measure of food chain contamination. The second tier is not always needed if chemical criteria are exceeded, but it may be necessary if no chemical criteria are exceeded to adequately protect against the potential effects of chemical mixtures or unmeasured chemicals. There was some discussion of the possible use of a third tier of more complex ecological measures such as fish disease incidence or community structure, which some workgroup members felt would be appropriate for large projects with adequate funding. The value of such measures is that they provide a true demonstration of *in situ* impact and may identify subtle but important ecological effects.

There was also some support (but no agreement) among workshop participants for lowering the significance level for statistical tests from 95 percent to 80-85 percent. Such a shift would be environmentally protective but would also increase the probability for false positive tests. This shift may be appropriate for screening-level analyses in which the quantity of data does not support a more rigorous level of analysis.

Threats to beneficial uses of a site may influence demand for cleanup or the level of cleanup. Examples of such threats include:

- Loss of fishery or other living resource (e.g., New Bedford, Massachusetts; Hudson River and its estuary, New York/New Jersey)

- Loss of swimming (e.g., Puget Sound, Washington; Union Lake, New Jersey)

- Loss of commercial development potential (e.g., Elizabeth River, Virginia).

The loss of development potential in the third case includes 1) decline in property values as a function of proximity to the site, and 2) exclusion of certain industries (e.g., marinas) if dredging is not allowed.

A number of technical questions were apparent in this session on "how clean is clean." These questions were summarized as follows:

1. What is the availability of nonchemical (e.g., biological) test methods? Several participants requested guidance on this subject. There was

disagreement as to whether the database is sufficiently developed to support nonchemistry-based analysis. A database of bioassay and bioaccumulation results for many chemical constituents is needed. There is also a need to define the role of biological testing in verifying sediment chemistry predictions of biological effects.

2. How should appropriate reference sites be selected to ensure meaningful comparison? Where can comparison data be found?

3. What other measures of ecological risk (besides bioassay/bioaccumulation results) should be used or developed, and what are the uncertainties associated with these other measures?

4. How should chemical data be collected to be efficient but still ensure measurement of all detrimental chemicals or degradation products?

5. For Superfund sites, are chemical data alone sufficient to establish the responsibility of sources or to further require cleanup? Should biological effects information be used to prove harm? It was observed by one region that only 1 of 60 sites (not all Superfund) had enough data on ecological impacts to facilitate cleanup requirements, although chemical monitoring data were abundant for almost all of the sites.

6. What statistical confidence level should be used for tests in various applications? Currently, a 95 percent confidence level is typically used, but use of a lower (e.g., 80-85 percent) confidence level for some purposes was discussed.

### Comparison of Sites and Problems

*To what extent can different sites or problems be compared? What unique site priorities might be given special case-by-case consideration?*

The site-specific nature of sediment contamination complicates attempts to perform cross-site comparisons or to rank the severity of contamination at a number of sites.

Although some approaches are appropriate to perform these comparisons, tiered methods were recommended when making comparisons for regulatory purposes.

The group was at issue with the utility and appropriateness of a national sediment standard against which all sites could be evaluated. While consistency and comparability are desirable outcomes of such a standard, sediment contamination is often a localized problem that requires flexible regulatory criteria.

## Communication Channels

*What communication channels are necessary among and within agencies setting priorities? Also, how can regional/headquarters communications be facilitated?*

Workgroup members stated that efforts should be made to reduce jurisdictional friction among regulatory agencies. Key federal and state agencies, along with the public, should be included early in the problem scoping and decision process for a given site to ensure that all interested parties have an opportunity to communicate their needs, responsibilities, and abilities to contribute to the project. Steering committees may be necessary for federal and state agencies to oversee the management of projects. These oversight groups could also look at problems on a regional basis and ensure that environmental standards are being met. New York has such an organization, which may form a model for other states. The organization includes the Corps, NOAA, EPA, FWS, and the states of New York and New Jersey. A 500-member Public Involvement Coordination Group also provides input for the decision-making process. Region 3 has formed a bioassessment workgroup to review sediment management work plans, evaluate data collection needs, and recommend appropriate ecological concerns. Members of this group include representatives from NOAA, the FWS, and EPA wetlands and technical support offices. Also, a national sediment oversight group has been created with representatives from the EPA Office of Water, Superfund, various EPA regions, and EPA/ORD and laboratories (e.g., Duluth, Narragansett, and Newport).

Concern was also expressed that more coordination in both research and implementation phases of projects is needed. Because agencies have different missions, this integration may be the only way that necessary research is ultimately accomplished given limited resources. It was encouraged, for example, that the cooperative research between

EPA/ORD and the Corps Waterways Experiment Station (WES) continue, with an emphasis on toxic sediment contamination issues.

### Information Needs

To facilitate understanding of contaminated sediment issues, many members of Workgroup I requested additional information on the following topics:

- List of official contacts, groups, and individuals involved in sediment management (e.g., specific program offices at EPA, specific responsibility offices at other state and federal agencies, lists of other agencies associated with sediment management)

- Guidance on types of testing possible and on developing consistent protocols (so tests are comparable among investigators)

- Available information in Superfund programs relevant to optional bioassay methods (i.e., for use in a second tier of testing; participants desired information on what can be used rather than what must be used).

## WORKGROUP II - SELECTING THE BEST MANAGEMENT ALTERNATIVE(S)

After establishing management priorities for different sites, a range of alternatives must still be considered for addressing contaminant problems at a particular site. Participants in Workgroup II focused on methods to select the best management alternative, after making the following assumptions at the start of the session:

- The workgroup is selecting the best management alternative for sediment that is contaminated and has been identified for priority action (i.e., fixing a known problem)

- A cleanup goal has been established and accepted (i.e., "how clean is clean" has been decided)

- For discussion of navigation management objectives, the sediment will be dredged (i.e., the focus is on disposal issues).

Workgroup discussion was organized in response to the general questions outlined in the following sections, which summarize the workgroup's conclusions and recommendations. For each question, the workgroup addressed useful approaches in the case studies (Appendix B), recommendations, needs, or additional work to answer the question. In addition, it was recognized that the response to each question may differentiate between navigation and cleanup management objectives. The proceedings are organized according to the differing responses (when applicable) for these two objectives.

### Regulatory and Cross-Program Constraints

*What regulations and cross-program constraints should be factored into the selection of management alternatives?*

The workgroup found little distinction between navigation and cleanup issues relevant to regulatory and cross-program constraints. In particular, it was noted that a "contagious" liability exists for materials that are designated under SARA or CERCLA (i.e., material transferred from Superfund sites tends to retain an actual or perceived liability that can implicate new sites). This liability, or perception of liability, can impede navigation projects as well as limit alternatives for sediment cleanup. It was concluded that there is a need for a procedure to waive this liability to facilitate cleanup and encourage cleanup contribution from navigation actions. Public education and integration of sediment contamination considerations into NPDES permits were identified as two ways to facilitate the resolution of liability issues.

Routine navigation dredging is frequently complicated by sediment contamination issues because the Corps (one of the major dredgers) has no specific authority for cleanup of sediments. Expenditure of maintenance dredging funds for cleanup is also limited by the "federal standard", barring specific congressional action (e.g., projects authorized under CWA Section 115).

The coordination of navigation dredging or cleanup projects requires consideration of a wide range of laws and regulations. It was concluded that the relationship of RCRA, TSCA, CERCLA, SARA, CWA, and MPRSA (see Appendix C) merits development of a policy that integrates waste management practices across all media. With specific regard to RCRA, it was noted that there are difficulties in applying RCRA technical procedures to classifying aquatic sediments. The extraction procedure (EP) toxicity test, which is used in the RCRA program to classify solid waste, does not characterize the true or full toxicity potential of sediments or soils. The proposed replacement of EP toxicity with the Toxicity Characteristic Leaching Procedure (TCLP) is still deficient because organic compounds are not considered. It was concluded that RCRA is not designed to address large volumes of low-concentration waste, which is often the problem at marine sites.

The workgroup noted that the preference to rely on accepted engineering practices is in conflict with the need expressed under SARA and CERCLA to consider innovative technologies for sediment remedial actions. Funding of demonstration projects for new technologies applicable to large sediment volumes is one mechanism for providing incentives to use innovative technologies. These technologies are often relevant to "permanent remedies," which are generally defined as those that permanently reduce the toxicity, mobility, or volume of contamination. Draft guidelines for considering reduction in contamination as an evaluation criterion have been recently issued by EPA (1988). The workgroup recommended that permanent remedies for sediment remedial action be better defined to acknowledge what can and cannot be done with sediments. For example, a clear definition of "acceptable permanence" is important to distinguish sediment capping, CAD, and specialized treatment followed by aquatic disposal (unconfined or confined).

Related to this issue and the earlier issue of "contagious liability", it was recognized that potentially responsible parties (PRPs) may be reluctant to remove, transport, and dispose of contaminated sediments at a different site (even a more secure site) because of potential new liabilities that are created. This perception of added liability increases pressure for the selection of onsite alternatives, which may not always be permanent. Also, clear definitions are needed to define or limit the liability associated with residues from treatment processes to provide incentive for selection of permanent solutions in both the technical and legal sense.

The general Superfund policy to conduct remedial action onsite was considered an impractical constraint for sediment remedial actions. Workgroup participants noted that onsite solutions may be precluded by navigation, high energy environments, or public perceptions. Also, given the present constraints on practical technology, selection of permanent remedies often involves disposal at a RCRA facility. Finally, since cleanup is required to meet substantive regulatory requirements, the workgroup recommended that mitigation policies be considered when selecting management alternatives.

### No-Action Alternative

*What site conditions or other factors make no-action the alternative of choice? How is "no action" defined?*

**Navigation Issues**--Workgroup recommendations are based on a definition of no-action for navigation as meaning no dredging. The no-action assessment should consider the impacts of the material if left in place compared with the benefits if removed, and the impacts at the disposal environment. The net effects of these impacts should be considered in deciding among alternatives.

The following key reasons for selecting the no-action alternative for dredging projects were identified:

1. Disposal sites are unavailable
2. Superfund liability overshadows navigation benefits
3. Solutions cannot be afforded.

In the case of Superfund liability with respect to a navigation dredging project, additional considerations will be required if cleanup is being considered as part of a sediment remedial action assessment. These requirements are discussed in the following section.

**Cleanup Issues**--The following two levels of no-action were identified by the workgroup as applicable to remedial actions associated with sediment cleanup:

1. No action with respect to either source control or sediment remedial action, including any institutional controls (i.e., no action as generally defined by NEPA)

2. No action with respect to sediment remedial action, including any institutional controls regarding direct exposure to sediments or to other media contaminated by association with sediments (although source control activities may occur).

The workgroup recommended that these alternative definitions of no-action be standardized and used in Superfund programs to avoid confusion on how to assess costs of the no-action alternative.

The no-action alternative for sediments was evaluated by the workgroup relative to potential short-term and long-term impacts. It was concluded that short-term impacts are generally manageable relative to long-term *in situ* risks of no action. This conclusion was reached because in contaminated sediment projects there has been a consistent pattern of initial concern regarding dredging resuspension, studies to determine degree of resuspension, and ultimately acceptance of dredging as a remedial tool. However, short-term losses of habitat can be critical at some sites and should be considered.

In assessing the merits of no action, the workgroup identified two major controlling factors:

- What are the effects of contamination if left undisturbed? Are contaminants in a biologically active zone or are they isolated? The biologically active zone often extends to only 10-20 cm in marine sediments; except in high-energy nearshore zone, particulate-bound contaminants that are buried below this zone can be considered effectively isolated (although not necessarily "permanent" over geologic time).

- What is the ability of sediments to naturally recover as the result of sediment deposition, source control, and effects of biological, chemical and physical mixing in the surface layer of sediment? The factors controlling recovery time can be modeled to estimate the potential for reduction in sediment contamination over time. For example, in the Commencement Bay Superfund project (Region 10), no sediment remedial action is proposed in cases where sediment contamination is projected to meet cleanup goals in 10 years solely through source control and natural deposition of cleaner sediment.

Natural resource damage assessments (NRDA) were also considered by the workgroup as a useful tool to assess the no-action alternative. Participants preferred cost-effective preliminary NRDA over complete assessments [i.e., either the standardized Type A procedure (53 FR 9769) requiring minimal field observation or the site-specific and more complex Type B procedure (51 FR 27674) codified in 43 CFR Part 11 and authorized under CERCLA Section 301(c)]. It was recommended that results of preliminary NRDA be used to provide some preponderance of evidence of ecological harm and that the analysis indicate the number of users of the resource (or associated resources). The latter factor is important for demonstrating relevance for priority assignment of funding. Limited ecological damage or low numbers of users of the resource were considered major reasons for preferring the no-action alternative. Some participants noted that ecological damage was often ignored relative to human health considerations, although there is limited information on the ultimate effect of ecological changes on humans.

The ability to clearly identify the relationship between ultimate users and the directly impacted resource is the major technical issue in using NRDA. It was suggested that demonstration NRDA at a limited number of sites would be useful in providing basic information that could be extrapolated to other sites.

In addition to technical factors, costs and institutional constraints can lead to the no-action alternative. Cost constraints may include a negative cost/benefit analysis in a dredging project or high costs required to implement cleanup goals based solely on technical factors for remedial action projects. Institutional constraints may include the inability to identify appropriate disposal sites.

### Sediment Remedial Action Alternatives

*What site conditions or other factors favor selection of specific alternatives (e.g., "in-place" containment or treatment; dredging and disposal; dredging, treatment, and disposal)?*

**Navigation and Cleanup Issues**--Issues unique to either navigation or cleanup are discussed in the following sections; however, there were several issues identified that pertained to both areas. In particular, it was considered inefficient for all projects to reconsider every technology. The following guidelines were summarized by the workgroup for recognition of appropriate technologies:

1. Many dredging/disposal technologies are worth considering only for smaller volumes or when highly mobile contaminants are present

2. In most cases, modifications to conventionally available equipment will suffice to conduct remedial action

3. Specialty dredges may be necessary as dictated by site factors (e.g., dredging around structures).

With respect to aquatic confinement for navigation or cleanup projects, the potential for episodic events, bioturbation, and diffusion of contaminants are the major factors that must be recognized in the design of caps.

**Navigation Issues**--The two major alternatives relevant to navigation projects are 1) dredging and disposal, and 2) dredging, treatment, and disposal. Treatment feasibility is primarily constrained by the volume of material (i.e., only small sediment volumes may be treated). To address water quality issues in upland disposal, treatment has often involved the addition of flocculants as a relatively inexpensive process. Other techniques for small sediment volumes include portable sand/carbon filtration units (e.g., used to remove kepone in James River sediment on the east coast and PCBs in Duwamish River sediment on the west coast) or solidification of homogeneous materials.

**Cleanup Issues**--In the absence of a need to perform maintenance dredging, cleanup alternatives for sediments may include institutional controls or *in situ* containment. Primary institutional controls include use restrictions, access restrictions, monitoring, and education programs. The workgroup concluded that such controls are a necessary component to sediment remedial action but are not sufficient in themselves, because once implemented the unresolved problem is often ignored, and the controls do not effectively discourage the already frequent user.

*In situ* containment of contaminated sediments is an important alternative for consideration in remedial action programs because of its relative simplicity and lower cost compared to removal, treatment, and disposal alternatives. This alternative is inappropriate for navigation channels, and there may also be a public perception problem for material that is contained and left at a site. In addition, more than a simple sand cap is necessary when there is groundwater recharge or infiltration, mobile contaminants, or a high-energy environment. A relatively impermeable layer of clay or alternative geotextile/geomembrane (e.g., polypropylene sheeting) may be required to retard the mobility of contaminants. Thick caps (e.g., >6 feet) or the rejection of containment alternatives may be required in dispersive environments.

### Disposal Alternatives

*How should risks associated with open-water, nearshore, and upland disposal be compared?*

The following range of options were considered by the workgroup for disposal of contaminated sediments:

- Onsite CAD (i.e., by removal of the contaminated layer, excavation of underlying clean material, disposal of the contaminated layer in the excavated area, and capping with the previously underlying clean material)
- Offsite CAD (i.e., at a defined aquatic disposal site)
- Nearshore disposal (typically in diked areas in which the disposal material is mounded above the water line)
- Land disposal of dredged material or dredged material mixed with other materials
- Dispersive ocean disposal (subject to international concerns).

The workgroup recommended that dispersive ocean disposal, although often discounted, be considered as an alternative. Key factors include advantages of reduced human health exposure and reduced concentrations through dispersion, and disadvantages of uncertain accountability and public perception. The official U.S. position in ocean disposal is to accept only total containment of contaminants, which discourages the alternative. A general issue raised during the final plenary session was whether beneficial uses of the assimilative capacity of the environment (e.g., ocean disposal) should be considered when adverse effects are not produced. The resolution of this issue would require a public education program because of the strong public perception against the concept. A second concern is the lack of a good technique for monitoring effects in deep ocean vs. nearshore environments, which raises accountability issues.

Strategies for comparing disposal alternatives were considered by the workgroup. It was concluded that there are available tools for quantitatively comparing human health and ecological risks of disposal alternatives. An example conceptual application of comparative risk analysis was presented (see Pastorok et al. 1986) for a comparison of 1) deepwater, unconfined disposal, 2) nearshore confined disposal, and 3) upland sanitary landfill disposal. The workgroup was divided as to whether there was a sufficient technical basis for quantifying these estimates at this time. Quantitative estimates are complicated by the substantial information and uncertainties in comparing different environments. Several participants concluded that the process of risk quantification can be a useful tool for evaluating assumptions but that the resulting numbers are often not a good way of expressing these risks to the public at large.

### Best Management Alternative

*How should one identify the best management alternative for a site?*

Several approaches to selecting the best alternative were presented to the workgroup for discussion, including the 1988 CERCLA guidance for cleanup (EPA 1988) and the Dredged Material Alternative Selection Strategy (DMASS) developed by the Corps/WES (Cullinane et al. 1986). Examples of evaluation criteria used at most CERCLA sites include:

- Institutional compliance [e.g., conformance to ARARS, other criteria, advisories, guidance; Note: guidance on ARARs has recently been released by the Office of Solid Waste and Emergency Response (EPA 1988; CERCLA Compliance with Other Laws)].

- Reduction in contamination (e.g., reduction in toxicity, mobility, or volume of contaminants)
- Protectiveness (e.g., public health/safety and timeliness as measures of short-term effectiveness; permanence as a measure of long-term effectiveness)
- Implementability (technical feasibility and availability)
- Cost (e.g., design and specifications, capital construction, operations and maintenance, monitoring).

In addition, under the National Contingency Plan (NCP), the evaluation of alternatives for CERCLA sites is usually conducted in two phases:

- Phase I - an initial screening of alternatives by consideration of cost (order-of-magnitude only), effects of alternatives (i.e., a consideration of the effective protection of public health, welfare, or the environment), and acceptability of engineering practices (i.e., feasibility, applicability, and reliability).
- Phase II - a detailed analysis of alternatives (with preference given to established technologies), including detailed cost estimation, consideration of engineering requirements, implementability, and constructability, and an evaluation of the extent of protection afforded, adverse impacts, and costs of mitigation.

Under the NCP, the selected alternative should be "the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare, or the environment."

**Navigation and Cleanup Issues**--No particular distinction was made for navigation and cleanup issues, but based on the review of available approaches, several "needs" were identified. Participants concluded that details of the assessment procedure need to be documented to substantiate project findings. A need was also identified for some "standard" for decision-making, although going through the selection procedure itself was considered to be of value even without a clear standard for making a final decision. Finally, participants expressed the need for a common mode of presentation of results, because the decision documents may serve as a basis for subsequent legal actions.

To be effective, the decision guidance for selecting the best alternative should clearly define when, where, and how costs should be considered. For example, following problem definition and an assessment of intangible factors that may be important, it was recommended that a preliminary analysis be conducted to estimate if the probable remedial costs were excessive. This analysis would not consider the financial ability of PRPs or a detailed cost-benefit analysis but could be used to assess relative impacts of alternatives (CERCLA guidance calls for a preliminary order-of-magnitude consideration of costs when screening alternatives). It was noted that EPA had a responsibility to advocate cleanup but that this responsibility had to be balanced against overregulation.

Timing issues were also raised with respect to sediment remedial action. Complete (100 percent) source control is unlikely to be feasible. Natural recovery times and kinetics of contaminant dispersion are also uncertain or unknown. Therefore, initiation of sediment remedial action may be desirable or necessary before source control is fully implemented. As part of the final solution, it may be appropriate to consider sediment maintenance as an extension of the source treatment process (i.e., combine partial source control and intermittent dredging as the best alternative).

To improve the ability to select among alternatives, the workgroup strongly recommended near-term demonstration projects on the most contaminated material that is now known. The results of these projects are needed to prove that remedial actions are feasible, to accelerate cleanup projects, and to enhance public relations. During the final plenary session, it was also noted that there is a need to involve special interest groups in the demonstration projects so that public education efforts are enhanced. Early involvement by agencies and special interest groups is desirable so that there is a clear understanding of the project context when results become available.

For the actual selection process, the workgroup was divided as to whether the evaluation matrix should be solely narrative or quantitative with supporting narrative.

If factors are quantified, the workgroup recommended that numbers in the evaluation matrix of alternatives be expressed as relative indices rather than as absolute criteria. As appropriate, some form of sensitivity analysis should be conducted to enable reporting of quantitative results as a range (e.g., costs).

**Recommended Alternative**--The best management alternative should consider combinations of institutional controls, source controls, navigation dredging where possible, and where necessary, sediment remedial action. A policy is needed that integrates waste management practices and requirements in all environments to resolve inconsistencies in standards and practices across programs and to enable consistent application of technical principles.

A suggestion was made to consider different classes of sediment quality (i.e., different standards for different areas or uses) in assessing alternatives. No consensus was formed, but a simple two-class system for relatively uncontaminated areas and more heavily contaminated areas might be necessary to form guidelines for what is the best alternative for remedial action.

The workgroup concluded that the alternatives evaluation is not a "bottom line" solution to be followed blindly, but rather a process for identifying the implications of key assumptions and developing an informed decision. Related to this decision process, there is a need within the cleanup program for improved information transfer procedures and possibly coordination requirements. Expert systems may be an appropriate tool for this field.

## WORKGROUP III - IMPLEMENTING THE SELECTED ALTERNATIVE(S)

The final phase of the overall management process for contaminated sediments involves implementation of the selected remedial alternative(s). Participants in Workgroup III addressed several questions that are outlined in the following sections. The workgroup focused primarily on procedures or approaches that could streamline the implementation process, resulting in more efficient and timely remediation of sediment contamination problems. Recommendations are limited by the fact that few toxic sediment projects have actually reached the point of implementation.

## Constraints to Implementation

*What major legislative or regulatory constraints are being encountered during implementation of alternatives?*

Several factors were identified by the workgroup that constrain or have the potential to constrain the implementation of remedial alternatives.

**Changing Rules and Regulations**--One of the most important factors involves the potential for regulatory change to occur during the implementation process. Examples of projects where such regulatory change has impeded the implementation process include the upper Hudson River PCB cleanup and the Everett Harbor dredging project (see Appendix B). An additional example discussed during the final plenary session related to potential >1 part per trillion dioxin standards for RCRA land disposal, which could force problems with disposal of dredged material. Dialogue between agencies was recommended to ensure defensible cleanup (i.e., regulations within one agency should be coordinated with overlapping regulations in another).

In cases where regulatory change has constrained implementation, the major contributory factor seems to be the excessive time required for the assessment and identification of remedial alternatives. During these periods of up to several years, it must be expected that the regulatory environment will change. In other cases, the program may be constrained by the incompatible changes in various federal regulatory programs (e.g., RCRA and CERCLA/SARA) or federal and state programs. Regardless of the source of the regulatory change, it is apparent that such changes will occur during any normal period of implementation. Therefore, the solution to this problem involves a recognition that such changes will occur in addition to the following strategy for adapting to change:

1. Keep the project moving as rapidly as possible. By shortening the overall assessment and implementation process, the potential for major legislative or regulatory changes affecting the project is reduced.

2. Maintain flexibility. It should be recognized that the regulatory environment may change. Therefore, the implementation plan should be sufficiently flexible to adapt to either anticipated or unexpected changes. It is important is such cases to maintain the basic logic of the plan while adapting to changing regulatory circumstances.

3. Maintain information flow on changes. An implementation project will be more adaptable to regulatory change if all involved parties are aware of the anticipated or existing changes. Therefore, it is important for the primary regulatory agency to disperse such information to PRPs, cooperating agencies, contractors, and the public so that these groups can also maintain flexibility.

**State and County Rules and Regulations**--A problem frequently encountered in sediment remediation is that the selected alternative(s) is incompatible with state or county rules and regulations. This situation has resulted in a state or county objecting to the selected alternative relatively late in the implementation process, resulting in wasted effort, last-minute delays, or frustration of the implementation process.

This kind of regulatory incompatibility has been a major problem for the Corps. In many cases, state rulings have resulted in loss of disposal alternatives or additional required studies.

A partial solution to this problem is to communicate **early** and **often** with all relevant state and local government agencies. This communication should have the goal of advising state and local governments on the project status and actions at the initial planning stages and periodically during the implementation process. Such enhanced communication will enable each agency to understand the other's role in the process and their regulations. It will also enable federal agencies to anticipate local or state government interests by not prematurely dismissing any reasonable alternative, or by early dismissal of alternatives that are clearly in conflict with state or local regulations.

The formation of interagency workgroups (IA) is one useful mechanism to facilitate communication and cooperation among agencies during the implementation process. An example of the successful use of an IA is PSDDA in Washington state. In this case, the federal regulatory agencies (EPA and Corps), the state regulatory agency (Ecology), and the state resource agency (Department of Natural Resources) all cooperated to define dredging and disposal standards for Puget Sound. There is a need to investigate the feasibility of IA in other areas.

An additional potential problem is inconsistency between states for projects crossing state boundaries. For example, in many cases there are inconsistencies among the states in policies regarding disposal of dredged material, hindering the nationally standardized approaches. In cases of potential inconsistencies among states, technical panels such as bioassessment groups (BAG) have been useful in promoting consistency and interagency cooperation. The New York/New Jersey BAG provides an example of such cooperation among states.

**Complex Pollutant Sources or Unregulated Sources**--In many coastal urban environments, sediment contamination may result from numerous point and nonpoint sources of pollution. These situations are characteristic of many of the major harbor areas on the east and west coasts and Great Lakes (e.g., New York Harbor, Indiana Harbor Canal, Elizabeth River, Los Angeles Harbor, San Francisco Bay, Commencement Bay). Many of sources of pollution in these areas are unknown or are currently unregulated (e.g., urban nonpoint sources). The problem is most severe at non-NPL sites that have complex sediment contamination problems (i.e., multiple contaminants of concern and multiple sources). There is presently no good regulatory program to enforce thoroughgoing source control and sediment remediation at such sites.

Assessment and remediation of these situations requires an integrated study of contamination and pollutant sources from an area-wide perspective. Because of the complexity of contamination and potential sources, it is not prudent to implement cleanup at a specific site without an evaluation of the interaction of adjacent sources and the potential for recontamination of the site. This problem is being addressed in Puget Sound by the Urban Bay Action Teams as part of PSEP, implemented under the EPA National Estuary Program. The application of such multiagency enforcement groups should be evaluated for other areas.

**Jones Act Restriction on Foreign Hulls**--The Jones Act restriction on the use of foreign-hull vessels was identified as a potential constraint to the use of some modern dredging equipment in the U.S. However, it was concluded that this potential constraint may be overcome by mounting the required equipment on a U.S. vessel.

**Early Assessment of NRDA Issues**--The possibility of an NRDA suit by a resource agency may be an impediment to negotiations between a PRP and regulatory agencies. The potential problem arises from NRDA issues not being raised early enough in the assessment and implementation process, thereby leaving open the potential for a suit at a later date. In this situation, the PRP may be hesitant to settle on a remedy before the NRDA issues are resolved.

The recommended solution to this potential problem is to have early notice and involvement of the resource agencies in the process. This early involvement would facilitate the identification of any NRDA issues prior to the implementation phases of the project. It would also facilitate the development of a covenant not to sue between the regulatory and resource agencies. The important objective is that the resource agencies should be on the same time frame as the regulatory agencies, and not become involved only in the later stages of the project. Preliminary Natural Resource Surveys (PNRS), which are agreements between EPA and NOAA, are one mechanism of ensuring timely involvement of resource agencies. These interagency agreements, which are currently implemented in EPA Regions 1 and 10, are being negotiated for other areas.

It may also be helpful to further develop the Type A and Type B NRDA methods (see discussion above by Workgroup II under **No Action Alternative: Cleanup Issues**), so they can be used as an early screening of NRDA issues. A simplified model is being developed for the Type A assessments to provide a screening of potential natural resource damages.

## Relationships Between Agencies and Potentially Responsible Parties

*Can relationships between agencies and potentially responsible parties be improved?*

The consensus of the workgroup was that the relationships between regulatory agencies and PRPs should be improved. The adversary relationships that may develop between agencies and PRPs can be a major impediment to timely implementation of remedial alternatives.

To overcome these potential adversary relationships, the objective should be to open up the process and reduce potential delays due to litigation. One solution is to involve the PRP early during the discussion of problems and remedial actions. This involvement will enable the regulatory agency to understand the PRP's concerns with various alternatives at an early phase of the project. In addition, the PRP will develop an understanding of the agency's direction on the project. During this phase it is also important that contact with the PRP be developed in tandem with all cooperating agencies so that the PRP is not receiving contradictory signals from the various agencies.

**Regulatory Implementation**

*What regulations, sources of funding, and payment methods by potentially responsible parties are most useful in pursuing action?*

The workgroup identified CERCLA/SARA and CWA as useful for remediation of contaminated sediments. CWA Section 115 is potentially useful in implementing cleanup actions if funding becomes available for this program. The major needs are for coordination of enforcement activities among agencies (state and federal) for source controls and sediment remediation. For example, there is a need for source control activities directed at urban nonpoint sources of pollution that contribute to sediment contamination. It was noted by the workgroup that the Urban Bay Toxics Action Teams in EPA Region 10 have made progress in this area. These teams result from a cooperative effort between state and federal personnel as part of the National Estuary Program in Puget Sound.

**Communication with Local Interests**

*What mechanisms have been most effective in communication and coordination with local interests and with the public?*

All workgroup members agreed that effective communication techniques are the key to maintaining public involvement and public support for the remedial project. The adequacy of communication with the public and other local interests can affect all other aspects of the project. Effective communication is too important to be conducted exclusively by the agency public relations staff. Therefore, it is important for project personnel to be involved in the planning and implementation of public information activities. This is important for the public to understand the issues and to develop a sense that the agencies are competent to implement the project.

An important requisite to adequate communication is to involve all relevant agencies early in the process. Public understanding can be accomplished only if there is agency cooperation. Alternatively, the public can be easily confused by a lack of agency cooperation or by different policies being advocated by different agencies. As part of this early involvement, it is also important to reach the key decision-makers in the public and all affected agencies. Academic personnel and technical personnel from other agencies should also be involved early. Subsequent activities can be effective only if these critical individuals are identified and involved in the planning and implementation process.

Risk communication is an increasingly important issue for toxic sediment problems during the implementation process. Adequate and clear communication of risks is also one of the most difficult aspects of public education. In discussing risk communication, the workgroup identified three areas that may be overlooked:

- When conducting risk communications, all presenters should be thoroughly briefed and prepared to cover all aspects of the situation.

- All risk evaluations should be presented in light of associated costs (i.e., what are the costs of risk reductions from various remedial alternatives?).

- Evaluations of risks should not be limited to cancer risks but should also include non-cancer and environmental risks in the overall assessment of alternatives.

The workgroup identified one aspect of risk communication as especially difficult to communicate to the public. This problem is associated with the differences between the FDA and EPA approaches to determining human health risks from contaminated seafood. The FDA approach is frequently used for some chemicals because it results in specific numerical criteria in the form of Action Levels or Tolerance Limits. Alternatively, the EPA method provides for the calculation of risk as a probability of cancer at a given tissue concentration.

EPA's Office of Water has recently produced a report, *Guidance Manual for Assessing Human Health Risks from Chemically Contaminated Fish and Shellfish* (Pastorok 1988), describing the relationships between the EPA and FDA risk assessment methods. The document also describes the steps of a recommended approach for conducting a health risk assessment for fish and shellfish, provides guidance on presentation of results, and summarizes uncertainties in the risk assessment methods.

A final area of communication identified by the workgroup as needing improvement involves cost balancing. The major need in this area is for agencies to be open regarding cost balancing as an important part of the process of evaluating alternatives. It is also important to describe the role of cost balancing in a straightforward manner that can be understood by the public. The following items were identified as key issues:

- Be honest that Superfund (or other programs) cannot clean up all contaminated sediments
- Admit that funds are not available for total cleanup; therefore it is important to direct funds to problem areas with the greatest hazard to the environment or to public health
- Clearly describe the cost balancing approach used, including a clear description of the decision-making approach and the criteria used.

### Implementation Time and Integration of Source Control

*How long is it taking to implement the chosen alternative(s)? Has there been adequate consideration of source control and natural recovery processes?*

The consensus of the workgroup was that it takes much too long to implement remedial alternatives once they are selected. The implementation process needs to be streamlined to affect timely implementation of the selected alternative. Many of the impediments to timely implementation that result from PRP litigation or last-minute intervention by local groups can be avoided by the previously discussed recommendations on planning, communication, and open involvement. A key aspect of timely implementation is **early involvement of the PRP**, in which the PRP participates in the selection and design of remedial alternatives. It was also noted by the workgroup that successful cleanups must be conducted and documented for the agencies to be perceived as responsible by the public and PRPs.

There is also a critical need to have flexibility in the implementation process to respond to immediate threats from sediment contamination, especially involving public health effects from contaminated seafood, water supplies, and direct sediment contact. In many cases, a large, complex area of contaminated sediments may have localized hot spots that are highly contaminated but spatially restricted near a point source discharge or spill site. If these areas pose a more immediate threat to the environment or to public health, they should be put on a more rapid implementation schedule than the overall study area.

The solution to this situation is to maintain the flexibility to implement remedial actions in phases in separate operable units. Given this flexibility, rapid responses can be directed toward restricted, highly contaminated areas. Identification of these areas should be accomplished early in the assessment or site characterization phases of the project. Rapid cleanup of such sites may then be facilitated by their small size because of the relatively straightforward evaluation of cleanup options when compared with very large areas of contaminated sediments.

The workgroup also identified a critical need for coordination of source control and sediment remedial actions during the implementation process. In situations where ongoing sources are contributing to sediment contamination, it is generally not advisable to implement expensive sediment cleanup alternatives if there is a possibility for near-term recontamination of the sediments. Therefore, prior to implementation of sediment cleanup, it is important to characterize the sediment contamination as resulting from either historical or ongoing sources. If the contamination results from ongoing sources, major ongoing sources should be identified and controlled prior to sediment cleanup.

Following source identification, the next important step is to evaluate the effects of source control on the future sediment contaminant levels. These evaluations include assessment of the natural recovery of sediments following partial or complete source control. The workgroup identified a key need for analytical tools to gauge the influence of source controls on the magnitude and extent of sediment contamination and to determine whether sediment contamination will recur if a sediment alternative is implemented. One such tool, the Sediment Contamination Assessment Model (SEDCAM), developed as part of the Commencement Bay Feasibility Study, and may have potential for application in other areas.

### Monitoring the Success of Remedial Actions

> *What criteria are being used to measure the success of remediation? Are contingency plans in place to respond to monitoring results? Is there an institutional framework for insurance, bonds, disposal site repair, and other necessary post-project concerns?*

Monitoring was identified as an important component of any sediment remediation program. As part of the monitoring program, criteria should be established to evaluate effectiveness of the remedial actions and determine if there is a release of contaminants from any sediment disposal sites. It was concluded that these criteria should be established on a site-specific basis.

The degree and kinds of monitoring data are dependent on a variety of site-specific factors, including contaminants present (e.g., metals vs. organics), spatial extent of contamination, involvement of food web organisms, relationship to transport mechanism (e.g., groundwater), and the kind of sediment remedial alternative (e.g., *in situ* treatment, capping, removal and offsite disposal). The workgroup concluded that, in general, the collection of only chemistry data may be appropriate to monitor smaller sites, whereas biological data will be desirable for larger sites, especially if there is contamination of fish and shellfish resources.

An important use of monitoring data is to determine whether the remedial action results in an elimination of the contaminant threat to the environment and to public health. If the post-remediation response is not as expected (i.e., the remedy fails), the following evaluations are recommended:

- Check the remedy (e.g., Was it properly executed according to design specifications? Was there a structural failure?)

- Evaluate fundamental assumptions and predictive relationships (i.e., Was the failure due to improper design of the remedial alternative?)

- Finally, the regulatory agencies should check for a re-opener in the consent judgement for the project.

The final part of this topic dealing with insurance, bonds, and other post-project liability concerns was not addressed by the workgroup because of a lack of expertise and experience by the workgroup members in these areas.

### Remedial Action Contingencies Plans

*Are the selected alternatives solving the sediment contamination problems? What action should occur if a selected alternative encounters significant opposition or is found to be technically flawed?*

In general there has been insufficient experience at contaminated sediment sites to develop overall conclusions on the effectiveness of various remedial alternatives. Because of this lack of direct application and because of new interest in contaminated sediments, some of the alternatives being evaluated or selected are untested in the field or are highly innovative in nature. Many of the alternatives that are potentially applicable to sediments have only been applied in pilot or bench-scale studies or have been previously tested only on soils.

The innovative and untested characteristics of many sediment remedial alternatives pose special problems for the agency project managers [e.g., Regional Project Managers (RPMs)] or other individuals involved in implementation activities. These individuals have limited experience with assessment and implementation of remedial alternatives for situations involving sediment contamination. Because of the limited experience and the lack of "off the shelf" solutions, these individuals may potentially select inappropriate options.

Support and training are two important factors in preventing this situation and ensuring that selections of remedial alternatives are based on sound technical considerations. First, it is important that the person in charge of the implementation project be supported by other parts of the agency with needed technical expertise. A critical need is for expert assistance in the areas of toxicology and human health effects. Links should be established with other parts of the agency to ensure prompt advisory service on relevant issues. Second, the site managers should receive specific training in the availability and applicability of sediment remedial alternatives to various contaminant problems. This is important because the characteristics of sediments result in very different remedial design considerations than those used for contaminated soils.

### Additional Implementation Approaches

*What additional approaches should be explored to accomplish remediation of toxic sediment problems?*

The workgroup concluded that there are substantial opportunities to "piggyback" toxic sediment removal projects onto maintenance dredging projects by the Corps and other entities involved in maintenance dredging (e.g., ports). This potential results from the co-occurrence of many sediment contamination problems in the inner harbor areas of major ports that are subject to siltation and require periodic channel deepening.

The opportunity to integrate toxic sediment remediation with maintenance dredging operations provides the possibility of relatively low marginal costs and less complex planning than is involved in a Superfund site effort. Some additional external funding may be required, however. The use of CWA Section 115 funds (see Appendix C and previous discussion by Workgroup I) should be evaluated for this purpose. This cooperative effort offers cost saving benefits to EPA and state regulatory agencies as well as to the Corps in that contaminant levels would be lowered for future navigation projects. Therefore, future consideration of disposal alternatives would be simplified.

## Institutional Arrangements

*Is there a need to improve institutional arrangements for sediment remediation?*

The consensus of the workgroup was that there is a definite need to increase the coordination among all agencies involved in sediment remediation projects (see previous section on IAs, for example). Several examples of successful integration of various agency programs were identified: the New York-New Jersey steering committee for dredged material disposal, PSDDA and PSEP in Region 10, the Region 5 Inter-Agency Workgroup on confined disposal facilities (CDF), and the Hudson River PCB Settlement Advisory Committee.

As discussed above, the interagency agreement between EPA and NOAA for Preliminary Natural Resource Surveys has been successfully implemented in Regions 1 and 10. It is recommended that extension of the interagency agreement be considered for other regions.

# CONSIDERATIONS FOR INTEGRATING TOXIC SEDIMENT MANAGEMENT STRATEGIES

In this section, key elements of the three components of sediment management (i.e., prioritization of problems, selection of management alternatives, and implementation of alternatives) are synthesized in an integrated framework to form the basis for planning activities and future development of sediment management strategies. This synthesis is not intended to be a comprehensive summary of all workgroup recommendations. Instead, interrelationships among the three management components are highlighted, consistent with the conclusions and recommendations of individual workgroups summarized in greater detail in the previous sections. This section was developed after the workshop by EPA/OPA and its contractor.

Specific management strategies for each area of interest were not always addressed or concluded by the workgroups. Hence, major unresolved issues that affect development of consensus on these strategies are also re-emphasized in this section.

## SETTING PRIORITIES FOR MANAGEMENT

Prior to assessing potential actions or implementing a specific action, the relative priority of different sites or areas within a site must be assessed to ensure that cleanup or dredged material management resources are appropriately focused. Workgroup I evaluated a wide range of issues concerning the setting of priorities, which are strongly influenced by the goal of the particular management program. In particular, differences between the goals of programs for dredged material disposal and sediment remedial action may well lead to different priorities for action.

### Unresolved Issues

The largest number of unresolved issues were identified in this portion of the workshop, including the following major issues:

- **Permitting:** Liability issues on who cleans up and who pays are clearly unresolved. This issue was noted in each of the three workgroups.

- **How Clean Is Clean:**

  - There were several requests for guidance on appropriate biological test methods (ecological and toxicological) and observations by some that the database is not sufficiently developed to support toxicological analyses for effects of specific chemicals.

  - A lack of availability or understanding of methods for selecting reference areas was cited as an obstacle to acceptance of assessment methods that use a reference area approach.

  - In Superfund projects, it was undecided as to the extent to which data besides chemistry (e.g., biological) should be used to determine PRP responsibility. Chemistry alone was considered insufficient by some for requiring cleanup.

  - Currently 95 percent confidence (i.e., alpha=0.05) is typically assigned in statistical tests. There was some discussion of lowering the confidence level to 80-85 percent for some purposes.

- **Navigational Dredging:**

  - The assumption in navigation dredging has generally been that protecting living resources is adequate to protect human health. Whether this is a protective assumption was questioned.

  - For dredged materials classified as contaminated, the technical justification and cost-efficiency of sometimes requiring steps required under RCRA for sediment disposal were questioned (e.g., why put a landfill liner in a nonpermeable sediment disposal site?)

  - There was concern as to whether current dredged material tests from the EPA/Corps "implementation manual" for ocean disposal are protective enough. It was noted that these methods are often applied for disposal in inland waters as well as the ocean. Because the sensitivity of the bioassays may be insufficient, it was noted that the methods are currently under revision (including, for example, publication of regional manuals). Work is also underway to develop compatibility of methods for assessing contamination under CWA Section 404 and the Ocean Dumping Regulations under MPRSA.

  - There was concern that although data collection by itself is perceived by the public as indicating that some beneficial action is being taken, more appropriate ways are needed to show the public that agencies are actively working to correct environmental problems.

- **Sediment Cleanup and Standards:**

  - It was unclear at what point costs should be taken into account in setting cleanup targets (a recurring question in other workgroups).

  - The workgroup was at issue over the utility and appropriateness of national sediment standards. While consistency is a very desirable outcome of such a standard, sediment contamination is often a very localized problem that requires flexible regulatory criteria.

### Overview

A definitive strategy for setting priorities was not formulated by Workgroup I, although a number of recommendations were made. In particular, the workgroup generally recommended that tiered testing strategies be used to assess priorities. An example of a simplified strategy for tiering tests based on chemical and biological assessments, developed by OPA and its contractor after the workshop, is shown in Figure 1. The specific need for testing will depend on the availability of existing information, as well

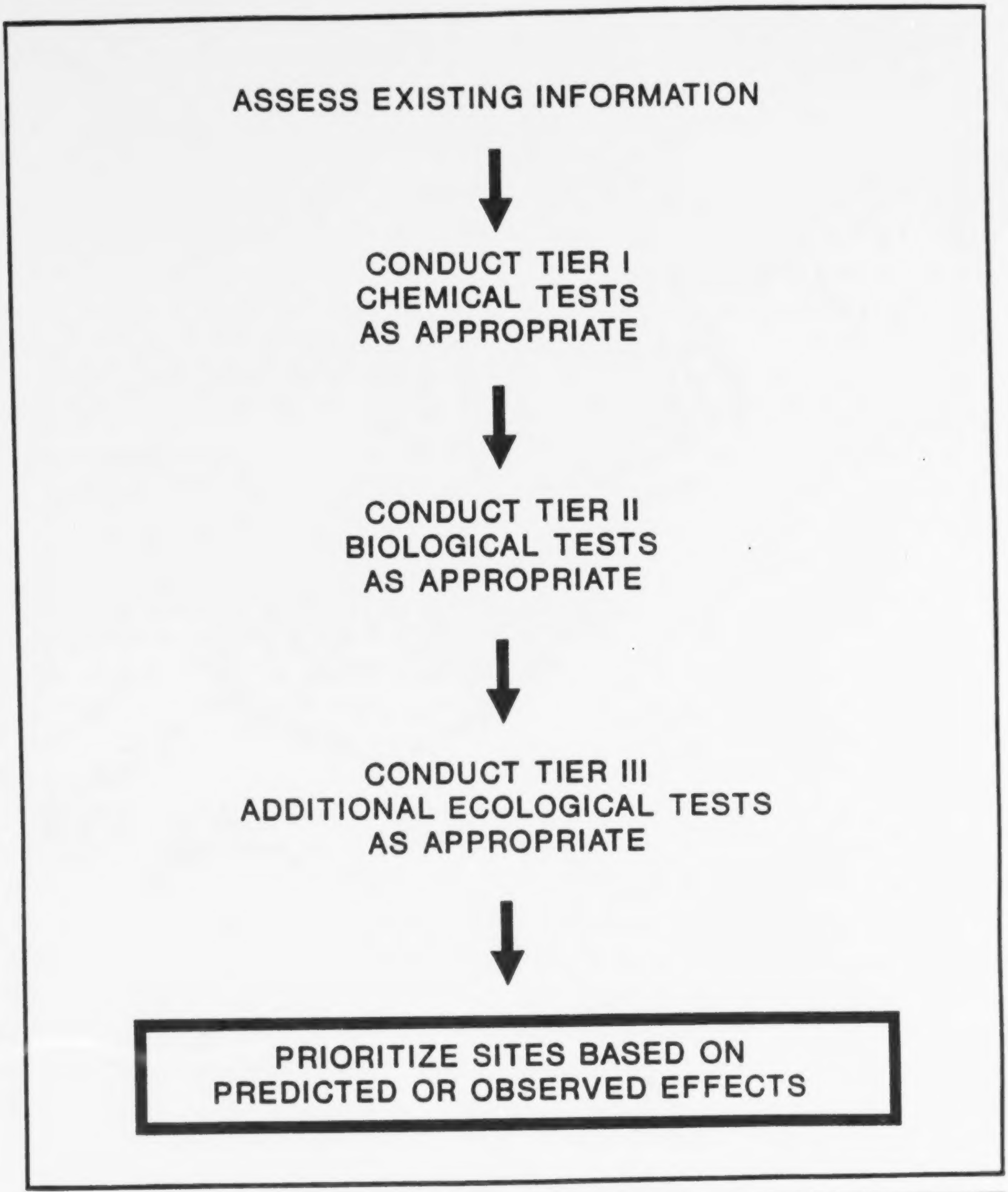
ASSESS EXISTING INFORMATION
CONDUCT TIER I CHEMICAL TESTS AS APPROPRIATE
CONDUCT TIER II BIOLOGICAL TESTS AS APPROPRIATE
CONDUCT TIER III ADDITIONAL ECOLOGICAL TESTS AS APPROPRIATE
PRIORITIZE SITES BASED ON PREDICTED OR OBSERVED EFFECTS

Figure 1. Generalized strategy for tiering chemical and biological tests.

as the degree of acceptance of predictive relationships embodied in sediment quality standards that relate chemical contamination and biological effects. For dredging projects, criteria based on both chemical and biological data may be used to rank different sites. Beneficial uses of dredging are also key considerations in deciding the final priorities for a particular project as well as for ranking potential disposal sites.

A generalized strategy for ranking sites for remedial action, developed after the workshop, is shown in Figure 2. Chemical or biological sediment quality values are used to interpret site-specific data on contamination and biological effects. From this assessment, problem areas and chemicals can be identified and prioritized for subsequent source identification efforts. A final priority for potential action could then be based on a final assessment of environmental and human health hazard posed by the contaminated sediments and a determination of the adequacy of source identification. A simplified decision process for prioritizing sediment remedial action relative to source control actions is shown in Figure 3 (presented during the workshop as part of Workgroup II). In general, sediment remedial action should be undertaken only when major sources of contamination have been identified and controlled. Because 100 percent source control may not be possible, a combination of source control and sediment remedial action may be necessary as part of the selection of a best management alternative. The determination of the best management alternative for each site may also affect priorities among sites, as discussed in the following section.

## SELECTING THE BEST MANAGEMENT ALTERNATIVE(S)

After establishing the need for action at a particular site, selection of the best management alternative (either for remedial action or for an appropriate disposal site for dredged material) can involve a wide range of technical and cost considerations. The particular action selected for a site may, therefore, modify the initial priority assigned to the site during problem identification. Workgroup II examined a variety of selection strategies, which have been used to develop a generalized strategy in this section.

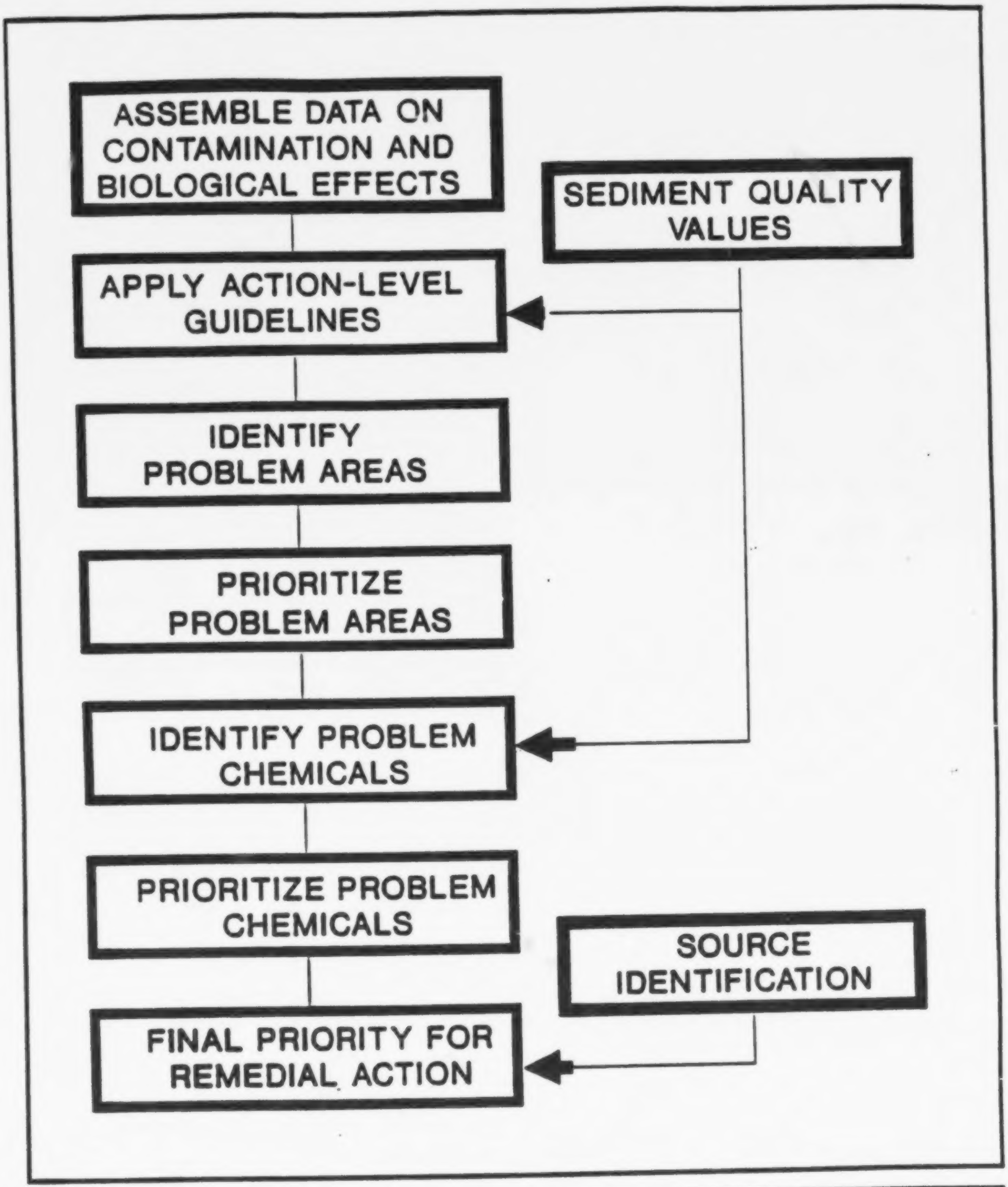
ASSEMBLE DATA ON CONTAMINATION AND BIOLOGICAL EFFECTS
SEDIMENT QUALITY VALUES
APPLY ACTION-LEVEL GUIDELINES
IDENTIFY PROBLEM AREAS
PRIORITIZE PROBLEM AREAS
IDENTIFY PROBLEM CHEMICALS
PRIORITIZE PROBLEM CHEMICALS
SOURCE IDENTIFICATION
FINAL PRIORITY FOR REMEDIAL ACTION

Figure 2. Generalized strategy for assigning priorities for remedial action.

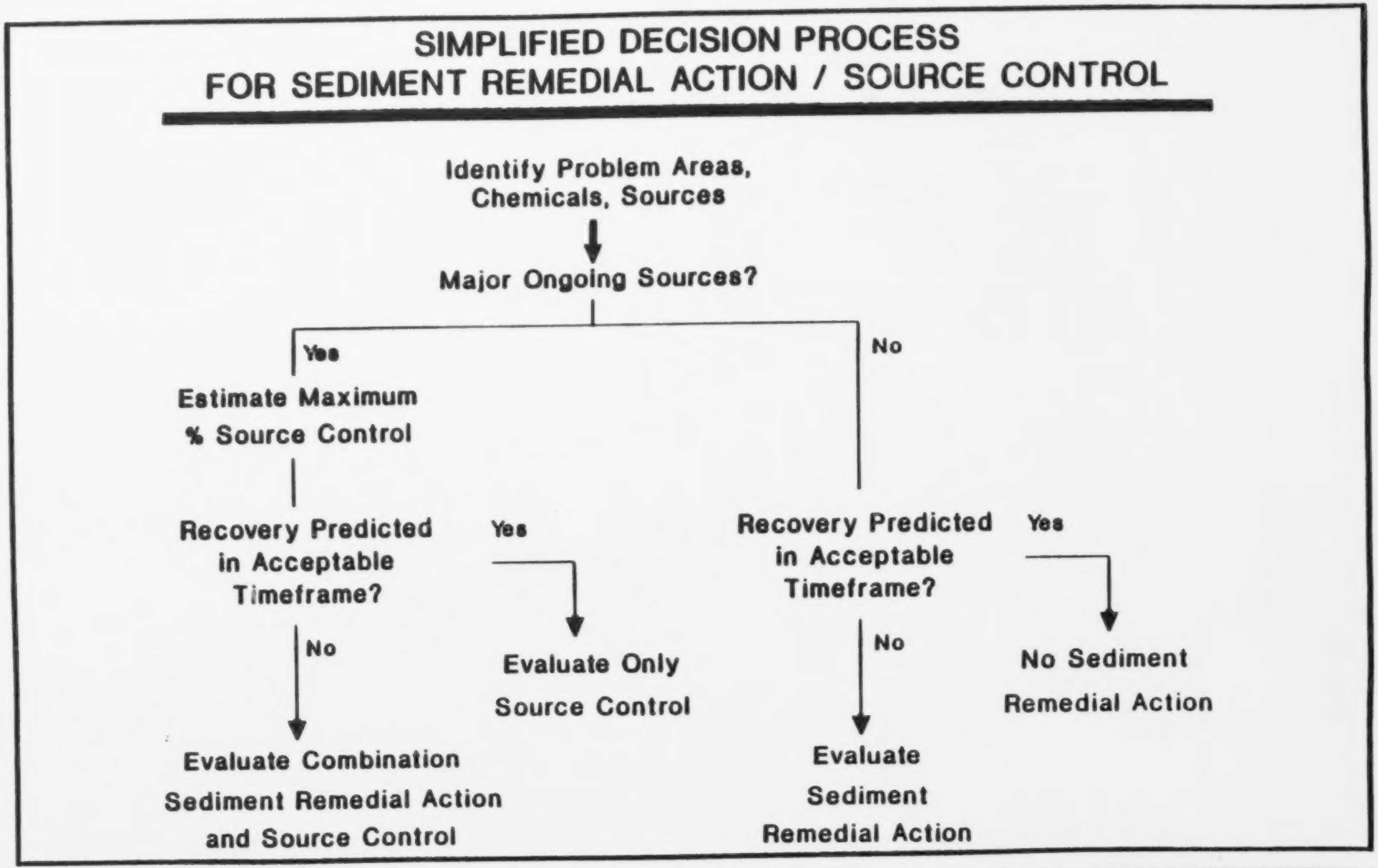
SIMPLIFIED DECISION PROCESS
FOR SEDIMENT REMEDIAL ACTION / SOURCE CONTROL
Identify Problem Areas, Chemicals, Sources
Major Ongoing Sources?
Yes
No
Estimate Maximum % Source Control
Recovery Predicted in Acceptable Timeframe?
Yes
No
Evaluate Only Source Control
Evaluate Combination Sediment Remedial Action and Source Control
Recovery Predicted in Acceptable Timeframe?
Yes
No
No Sediment Remedial Action
Evaluate Sediment Remedial Action

Figure 3. Simplified decision process for sediment remedial action/source control.

**Unresolved Issues**

Major unresolved issues identified by Workgroup II included the following:

- **Cross-Program Constraints:**
  - PRPs are reluctant to dredge and dispose because they gain liability at the new disposal site. These concerns lead to pressure for onsite disposal, which should be recognized in the selection process.
  - It is not always evident when after treatment a residue no longer retains Superfund liability. There should be clear definitions so that at some point wastes or residues from treatment processes can be deregulated.
- **No-Action Alternative:**
  - The definition of "no action" is ambiguous among programs and should be made consistent (at least by clearly defining assumptions concerning whether institutional controls imply "action")
  - It was noted that better definition is required for determining how to weigh ecological/environmental concerns in rejecting the no-action alternative. It was generally observed that some preponderance-of-evidence requirement should be used to make the case for ecological harm before rejecting the no-action alternative.
- **Sediment Remedial Alternatives:**
  - Although controversial, the beneficial use of the assimilative capacity of the environment was raised as a possible consideration when choosing disposal options.
  - The use of quantitative risk assessment is an issue based on the discrepant views of the workgroup on how to report results to the public. The release of numbers should be controlled in some way, but at the same time there was a need expressed to identify decision

rules using risk assessment. Issues revolve around clearly defining what is to be protected and for how long (both at the disposal site and the dredged site). There was a concern by one participant that there was too much information for different environments to be able to come to an effective conclusion.

- **Selection of the Best Alternative:**

  - There was discussion as to how much of an advocate for environmental protection EPA should be. If EPA acts as a constant advocate there is the danger of losing credibility, although credibility can also be lost if an advocacy position is not taken. There also appeared to some to be a double standard regarding funding; public funds may be rationed, but PRP funds are readily attached with much less regard for cost effectiveness.

  - When costs should be considered was not fully resolved. One suggested approach for early consideration of costs was to first ask "What is the problem?", then "What are the intangibles that may require protection?", and finally "Is the cost excessive? It was suggested that such a preliminary cost analysis definitely should not consider whether the PRP can afford it and should not be a detailed cost/benefit analysis, but should provide some sense as to whether the project was cost effective.

  - The quantification of guidance for selecting alternatives was not fully resolved, but some felt that the guidance should be cast as relative indices, not "criteria". With relative indices the bottom line was judged to be more easily defined, although the need for some kind of sensitivity analysis was also expressed (i.e., presentation of results as a range for each alternative).

### Overview

Selection strategies for dredged material disposal options have been refined by the Corps for general use. The basic approach is incorporated into a decision-making framework, which is shown in simplified form in Figure 4. Using this framework, a phased process for selecting a dredged material alternative has been formulated, as shown in Table 2. The DMASS process is used to identify important contaminants and pathways; to rank the importance of pathways according to site-specific factors; to develop, screen, evaluate, and rank disposal alternatives; and to provide a final selection using a variety of technical and cost criteria. The DMASS process coupled with the decision-making framework developed by the Corps provides an integrated approach to disposal site prioritization and selection of management alternatives. However, DMASS does not explicitly include some items relevant to toxic sediments, for example, an assessment of human health risk.

At contaminated sites, managers are faced with a wide range of alternatives, shown in Table 3. Only some of these alternatives involve dredging and disposal activities. It should be noted that the no-action alternative can be defined in a manner consistent with NEPA (i.e., no sediment or source control action of any type) if control of discharges, which might proceed in the absence of sediment remedial action, is considered as one of several possible institutional controls.

A phased approach to screening and evaluating these remedial alternatives has been recommended in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Table 4). The NCP establishes the process for determining appropriate removal and/or remedial actions at Superfund sites (Federal Register Vol. 50, No. 224, p. 47946). This approach has several parallels to the DMASS approach for disposal site selection (Table 2). Evaluation criteria recommended under CERCLA/SARA guidance (Table 5) also share characteristics of several of those used in DMASS (Table 2). However, remedial alternatives address a much wider range of remedial technologies and process options (e.g., Figure 5) than is required for navigation dredging projects. At least one detailed alternative for each of the general categories of alternatives shown in Table 3 is recommended for analysis to facilitate a balanced remedy. Not all of the potential technologies are equally implementable, even for more routine dredging and disposal alternatives (e.g., see Table 6). The initial and final detailed screening of alternatives will eliminate many proposed remedial technologies because of the lack of information regarding their applicability to marine sediments.

A useful technique for comparing cost and technical criteria for different alternatives is shown in Figure 6. All three workgroups were divided as to when costs should be

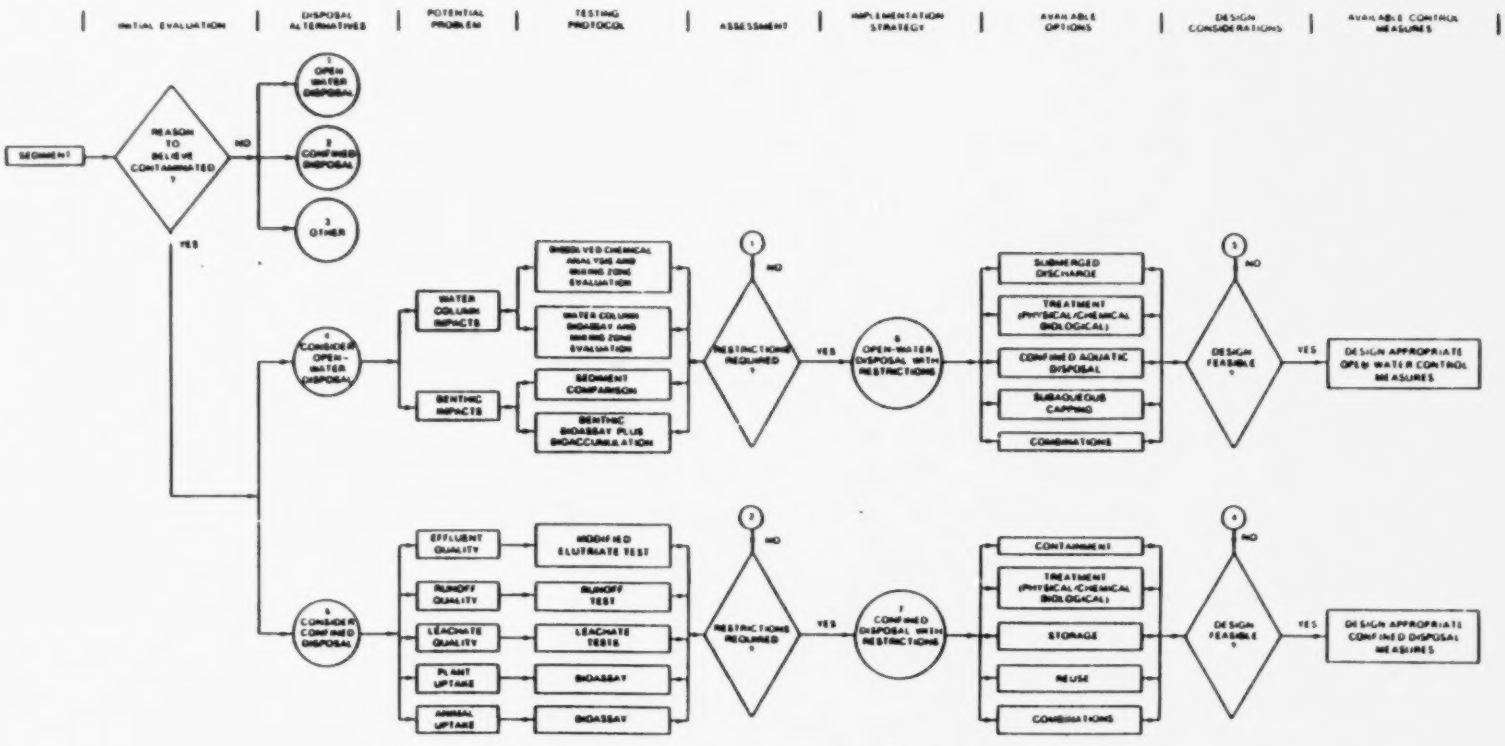

Figure 4. Basic decision-making framework for dredged material disposal.
(Reference: Lee et al. 1985)

## TABLE 2. SUMMARY OF THE DREDGED MATERIAL ALTERNATIVE SELECTION STRATEGY (DMASS) PROCESS

(Reference: Cullinane et al. 1986)

| Phase | | Step | Purpose | Criteria Used |
|---|---|---|---|---|
| I. | Presumption of contamination pathway | | Apply decision-making framework to identify contaminant type, level, and pathway | Decision-making framework and related regional administrative decisions |
| II. | Confirmation of contamination pathway (site-specific) | 1. Select potential sites | Eliminate poor or inferior sites | 1. Availability<br>2. Distance<br>3. Capacity<br>4. Cost<br>5. Impact |
| | | 2. Assess site characteristics | Determine attributes of sites | |
| | | 3. Identify pathways of concern | Is pathway identified in Phase I as concern at site? | |
| | | 4. Select dredge/transport technique | For potential sites and pathways, eliminate poor transport combinations | 1. Impact<br>2. Cost<br>3. Compatibility |
| | | 5. Site constraints Check compatibility | Are remaining site-dredge/transport options compatible? | |
| III. | Alternative development and initial screening | 1. Select potential technologies | Identify suitable combinations of technologies | 1. Impact<br>2. Cost<br>3. Accepted engineering practice |
| | | 2. Develop alternatives | Combine technologies and sites | |
| | | 3. Screen alternatives | Eliminate poor or inferior alternatives | |

TABLE 2. (Continued)

| Phase | | Step | Purpose | Criteria Used |
|---|---|---|---|---|
| IV. | Detailed evaluation and ranking | 1. Evaluation of alternatives | Extensive evaluation of remaining alternatives | 1. Cost<br>2. Operation & Maintenance<br>3. Reliability<br>4. Safety<br>5. Regulatory requirements<br>6. Implementability and availability<br>7. Public acceptance<br>8. Environmental impact<br>9. Technical effectiveness |
| | | 2. Ranking of alternatives | Arraying of alternatives for easy comparison | Same as above |
| V. | Alternative selection | | | |

## TABLE 3. GENERAL CATEGORIES OF SEDIMENT REMEDIAL ACTION ALTERNATIVES

- No Sediment Remedial Action (i.e., Natural Recovery Only)
- Institutional Controls (Including Source Control)
- *In Situ* Containment (Capping)
- Removal and Disposal
- Removal, Treatment, and Disposal

## TABLE 4. NATIONAL CONTINGENCY PLAN EVALUATION OF ALTERNATIVES

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### PHASE I: INITIAL SCREENING OF ALTERNATIVES

- Cost
  - Initial
  - O&M
  - (order-of-magnitude cost/benefit analysis)
- Effects of Alternative
  - Adverse environmental effects
  - Effectiveness of source control
  - (Effective protection of public health, welfare, or environment)
- Acceptable Engineering Practices
  - Feasible
  - Applicable
  - Reliable

### PHASE II: DETAILED ANALYSIS OF ALTERNATIVES

- Emphasis on Established Technology
- Detailed Cost Estimation
- Engineering, Implementation, or Constructability
- Extent of Protection
- Adverse Impacts and Costs of Mitigation

### THE SELECTED ALTERNATIVE SHOULD BE:

> "the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare, or the environment."

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## TABLE 5. CERCLA/SARA EVALUATION CRITERIA TO DETERMINE APPLICABLE REMEDIAL TECHNOLOGIES

**Institutional Compliance**

- Applicable or Relevant and Appropriate Regulations (ARAR)
- Other Criteria, Advisories, Guidance

**Reduction in Contamination**

- Toxicity
- Mobility
- Volume

**Protectiveness**

- Short-term Effectiveness:
    - Public Health/Safety
    - Timeliness
- Long-term Effectiveness:
    - Permanence

**Implementability**

- Technical Feasibility:
    - Constructability
    - Demonstrated Technologies
    - Available Contingencies
    - Operation and Maintenance
    - Monitor Effectiveness
- Availability:
    - Equipment in Region
    - Materials/Specialists in United States
    - Local Treatment/Storage/Disposal Facilities

**Cost**

- Design and Specifications
- Capital Construction (Direct and Indirect Costs)
- Operations and Maintenance
- Monitoring

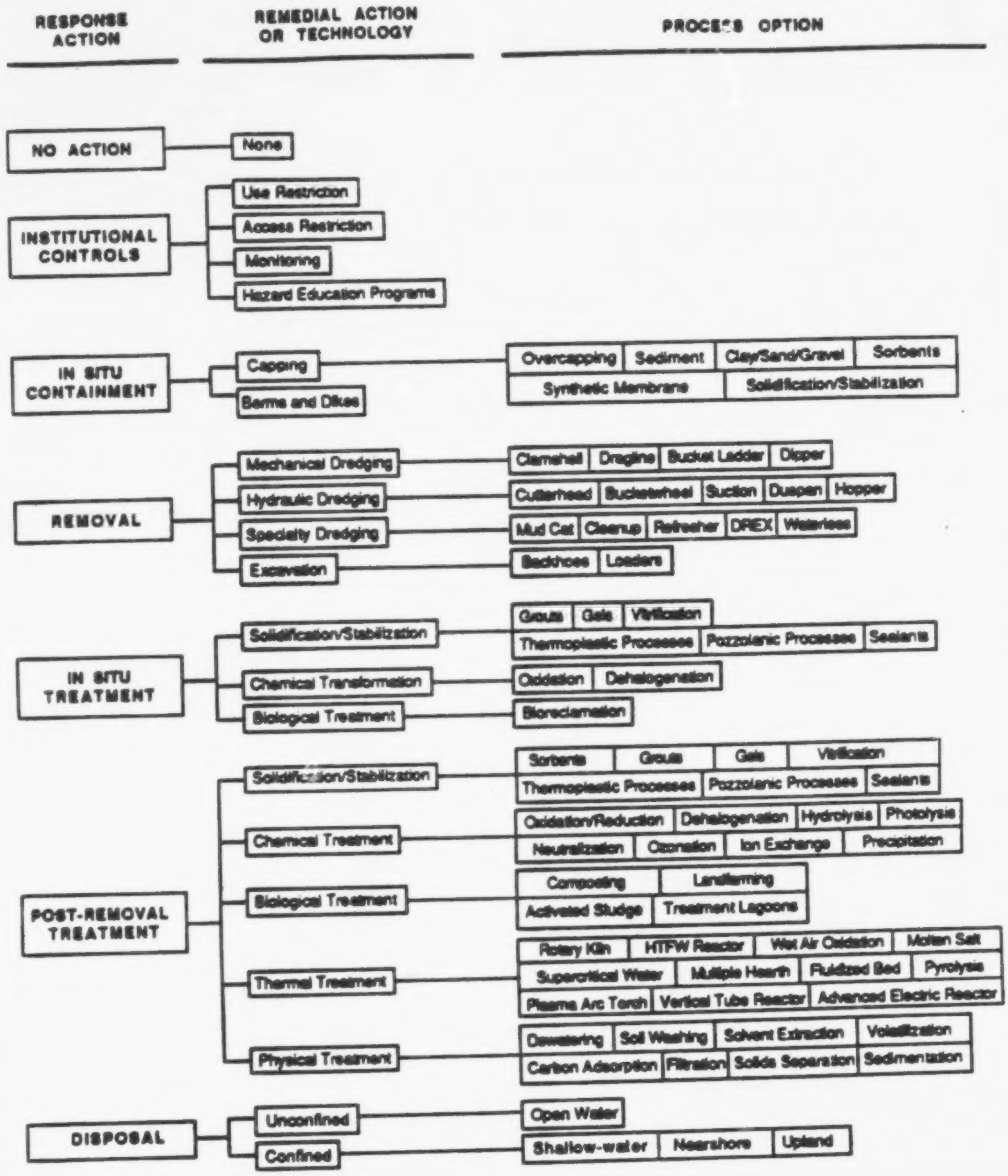


Figure 5. Example sediment remedial technologies and process options. (Reference: Tetra Tech 1987)

## TABLE 6. STATUS OF APPLICATION OF CONTROL/TREATMENT TECHNOLOGIES
(Reference: Cullinane et al. 1986)

| Technology | Proven[a] | Demonstrated | Demonstrable | Conceptual |
|---|---|---|---|---|
| Controls During Dredging | | | | |
| Dredge selection | X | X | | |
| Barriers | X | X | | |
| Operational controls | X | X | | |
| Controls During Transport | | | | |
| Hopper dredges | X | X | | |
| Specialized barges | X | | X | |
| Pipeline controls | X | | X | |
| Pump controls | X | | X | |
| Route/navigation controls | X | | X | |
| Loading/unloading controls | X | | X | |
| Truck transport | X | | X | |
| Rail transport | X | | X | |
| Restricted Open-Water Disposal | | | | |
| Submerged diffuser | X | | X | |
| Gravity-fed downpipe | X | | X | |
| Hopper dredge pump down | | | | X |
| Solidification/stabilization | | | | X |
| Capping | X | | X | |
| Lateral confinement | | | X | X |
| Restricted Upland Disposal | | | | |
| Covers | X | | X | |
| Surface sediment stabilization | X | | X | |
| Liners (synthetic) | X | | X | |
| Liners (soil) | X | | X | |
| Slurry walls | X | | X | |
| Surface-water controls | X | | X | |
| Subsurface drainage | X | X | | |
| Groundwater pumping | X | | X | |
| Sheet piling | X | | X | |
| Site security | X | | X | |
| Settling basins | X | X | | |
| Stationary screens and sieves | X | | | X |
| Moving screens | X | | | X |
| Hydraulic classifiers | X | | | X |
| Spiral classifiers | X | | | X |
| Cyclones and hydrocyclones | X | | X | |
| Solidification/stabilization | X | | X | |

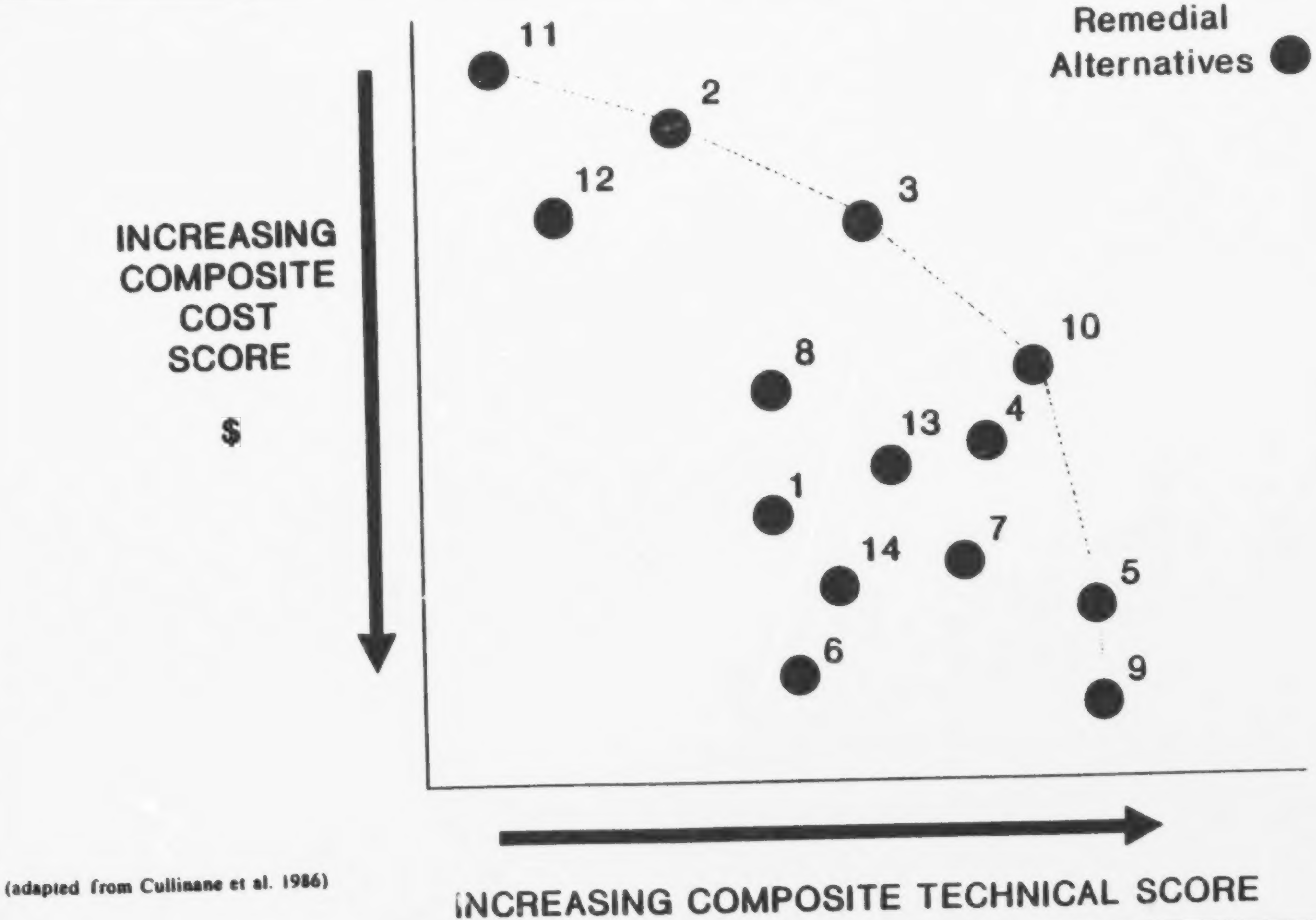
TABLE 6. (Continued)

| Technology | Proven[a] | Demonstrated | Demonstrable | Conceptual |
|---|---|---|---|---|
| Rotary-kiln incineration | X | | | X |
| Multiple-hearth incineration | X | | | X |
| Fluidized-bed incineration | X | | | X |
| | | | | |
| Extraction | X | | | X |
| Immobilization | X | | | X |
| Degradation | X | | | X |
| Attenuation | X | | | X |
| | | | | |
| Chemically-assisted clarification | X | X | | |
| Filtration | X | X | | |
| Chemical precipitation | X | | X | |
| Carbon adsorption (metals) | X | | | X |
| Chemical reduction | | | | X |
| Chemical oxidation | | | | X |
| Ion exchange | | | | X |
| | | | | |
| Carbon adsorption (organics) | X | | X | |
| Biological treatment | | | | X |
| Stripping | | | | X |
| | | | | |
| Chlorination | | | | X |
| Ozonation | | | | X |
| | | | | |
| Distillation | | | | X |
| Electrodialysis | | | | X |
| Reverse osmosis | | | | X |
| | | | | |
| Restricted Nearshore Disposal | | | | |
| | | | | |
| Covers | X | | X | |
| Surface-sediment stabilization | X | | X | |
| Liners (synthetic) | X | | X | |
| Liners (soil) | X | | X | |
| Slurry walls | X | | X | |
| Surface-water controls | X | X | | |
| Subsurface drainage | | | | X |
| Groundwater pumping | | | | X |
| | | | | |
| Sheet piling | X | | X | |
| Site security | X | | X | |
| | | | | |
| Settling basins | X | X | | |
| Stationary screens and sieves | X | | | X |
| Moving screens | X | | | X |

TABLE 6. (Continued)

| Technology | Proven[a] | Demonstrated | Demonstrable | Conceptual |
|---|---|---|---|---|
| Hydraulic classifiers | X | | | X |
| Spiral classifiers | | | | |
| Cyclones and Hydrocyclones | X | | X | |
| Solidification/stabilization | X | | X | |
| Rotary-kiln incineration | X | | | X |
| Multiple-hearth incineration | X | | | X |
| Fluidized-bed incineration | X | | | X |
| Extraction | X | | | X |
| Immobilization | X | | | X |
| Degradation | X | | | X |
| Attenuation | X | | | X |
| Chemically-assisted clarification | X | X | | |
| Filtration | X | X | | |
| Chemical precipitation | X | | X | |
| Carbon adsorption (metals) | X | | X | |
| Chemical reduction | X | | | X |
| Chemical oxidation | X | | | X |
| Ion exchange | X | | | X |
| Carbon adsorption (organics) | X | | X | |
| Biological treatment | X | | | X |
| Strippling | X | | | X |
| Chlorination | X | | | X |
| Ozonation | X | | | X |
| Distillation | X | | | X |
| Electrodialysis | X | | | X |
| Reverse osmosis | X | | | X |

[a] Proven in concept which may also have been demonstrated or is demonstrable; unproven technologies are by definition only conceptual although the concept may be demonstrable.



(adapted from Cullinane et al. 1986)

Figure 6. Comparative display of composite cost and technical criteria.
(adapted from Cullinane et al. 1986)

incorporated into a management strategy for contaminated sediments, although in general, some early consideration of the magnitude of costs was recommended. Analysis of Figure 6 indicates that the best alternatives are those shown on the dotted envelope of the cost-technical criteria graph. For example, any alternative not on the dotted line can always be replaced by a less expensive and technically superior alternative on the dotted line (e.g., Alternative 8 of the 14 alternatives is less favored than either Alternative 3 or 10, which have higher composite technical scores and lower composite cost scores). Differentiation of alternatives along the dotted line results from a final weighing of cost vs. technical factors.

## IMPLEMENTING THE SELECTED ALTERNATIVE

Workgroup III noted that there is considerably less experience in actually implementing management alternatives in response to sediment contamination concerns than in either prioritizing problems or in selecting management alternatives. A number of recommendations were developed for increasing communication, better defining project implementation needs, and outlining implementation steps based on a common-sense approach to sediment management.

### Unresolved Issues

No major unresolved issues were noted by Workgroup II. A concern was observed over the appropriate way to evaluate the need for bonding, insurance, and other issues related to cleanup liability. Resolution of this issue is important for successfully moving projects into an implementation phase but was considered beyond the specific expertise of the group.

### Overview

Regulatory change is often a primary issue of concern because many sediment management projects continue over several years and often include a number of phases that require different approaches to management. In the face of regulatory change, the following strategy for adapting to change was recommended:

- Keep the project moving as rapidly as possible. By shortening the overall assessment and implementation process, the potential for major legislative or regulatory changes affecting the project is reduced.

- Maintain flexibility. It should be recognized that the regulatory environment may change. Therefore, the implementation plan should be sufficiently flexible to adapt to either anticipated or unexpected changes. It is important is such cases to maintain the basic logic of the plan while adapting to changing regulatory circumstances.

- Maintain information flow on changes. An implementation project will be more adaptable to regulatory change if all involved parties are aware of the anticipated or existing changes. Therefore, it is important for the primary regulatory agency to disperse such information to PRPs, cooperating agencies, and contractors so that these groups can also maintain flexibility.

If the post-remediation response is not as expected (i.e., the remedy fails), the following evaluations were recommended:

- Check the remedy (e.g., Was it properly executed according to design specifications? Was there a structural failure?)

- Evaluate fundamental assumptions and predictive relationships (i.e., Was the failure due to improper design of the remedial alternative?)

- Finally, the regulatory agencies should check for a re-opener in the consent judgment for the project.

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## GLOSSARY OF ABBREVIATIONS

| | |
|---|---|
| ARAR | Applicable or Relevant and Appropriate Requirements under CERCLA/SARA |
| Authority | Puget Sound Water Quality Authority |
| BAG | BioAssessment Groups |
| CAD | Confined Aquatic Disposal |
| CDF | Confined Disposal Facility |
| CECW-D | Corps Chief of Engineers Civil Works - Dredging |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CERCLIS | Comprehensive Environmental Response, Compensation and Liability Information System |
| Corps | U.S. Army Corps of Engineers |
| CSO | Combined Sewer Overflow |
| CWA | Clean Water Act |
| CZMA | Coastal Zone Management Act |
| DEQE | Massachusetts Department of Environmental Quality Engineering |
| DMASS | Dredged Material Alternative Selection Strategy |
| Ecology | Washington State Department of Ecology |
| EIS | Environmental Impact Statement |
| EP toxicity | Extraction Procedure (toxicity test) |
| EPA | U.S. Environmental Protection Agency |
| FDA | Food and Drug Administration |
| FWS | U.S. Fish and Wildlife Service |
| GE | General Electric Co. |
| GIS | Geographic Information System |
| HRS | EPA Hazard Ranking System |
| IA | InterAgency workgroups |
| MCL | Maximum Contaminant Level |
| Metro | Municipality of Metropolitan Seattle |
| MPRSA | Marine Protection Research and Sanctuaries Act |
| NCP | National Contingency Plan |
| NDAA | National Defense Authorization Act |
| NEPA | National Environmental Policy Act |
| NJDEP | New Jersey Department of Environmental Protection |
| NOAA | National Oceanic and Atmospheric Administration |
| NOPA | National Ocean Program Act |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | EPA National Priorities List |
| NRDA | Natural Resource Damage Assessments |
| NYSDEC | New York State Department of Environmental Conservation |

| | |
|---|---|
| OERR | EPA Office of Emergency and Remedial Response |
| OMEP | EPA Office of Marine and Estuarine Protection |
| OPA | EPA Office of Policy Analysis |
| OPPE | EPA Office of Policy, Planning and Evaluation |
| ORD | EPA Office of Research and Development |
| OSHA | Occupational Safety and Health Act |
| OWRS | EPA Office of Water Regulations and Standards |
| PAH | Polynuclear Aromatic Hydrocarbons |
| PICG | New York/New Jersey Public Involvement Coordination Group |
| PCB | PolyChlorinated Biphenyl |
| PNRS | Preliminary Natural Resource Surveys |
| POTW | Publicly-Owned Treatment Works |
| PRP | Potentially Responsible Party |
| PSDDA | Puget Sound Dredged Disposal Analysis |
| PSEP | Puget Sound Estuary Program |
| RCRA | Resource Conservation and Recovery Act |
| RfD | Reference Dose (previously called Acceptable Daily Intake) |
| RI/FS | Remedial Investigation/Feasibility Study |
| ROD | Record Of Decision |
| RPM | EPA Regional Project Manager |
| SARA | Superfund Amendments and Reauthorization Act |
| SEDCAM | SEDiment Contamination Assessment Model |
| SMP | Shoreline Management Plan |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TSCA | Toxic Substances Control Act |
| WES | Corps Waterways Experiment Station |
| ZSF | Zone of Siting Feasibility |

# APPENDIX A

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# APPENDIX B

# CASE STUDY SUMMARIES

# CASE STUDY - MAY 1988
# UPPER HUDSON RIVER PCB SITE

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## SITE BACKGROUND

**1. Where is the site located, how large is the site, and what are the major environmental problems and sources of contamination?**

Approximately 200 miles of the Hudson River were contaminated by polychlorinated biphenyls (PCBs) discharged by two capacitor factories in the Upper Hudson River Basin. The Upper Hudson River Superfund site is a 40-mile stretch of river composed of a series of pools formed by low-level dams that are part of the Champlain Canal System.

**2. Under what authority is this project being pursued?**

The project is currently being pursued under direct approval of cleanup funds by Congress (under the federal Clean Water Act) and the New York State Legislature for the cleanup of contaminated river sediment, and Superfund remedial planning and cleanup for contaminated soil on the river banks.

**3. What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?**

Agencies with primary responsibility for site investigations, planning, and cleanup are the New York State Department of Environmental Conservation (NYSDEC), the New York Hazardous Waste Siting Facility Board, and the EPA.

**4. What is the time-frame, current status, and approximate cost of the project?**

Problems with gross contamination of Hudson River fish first came to light in the early 1970s. Health advisories for consumption of fish from the lower river, a ban on commercial striped bass fishing, and a complete ban on fishing in the upper river have been in effect since the mid-1970s. In 1975, NYSDEC and the General Electric Corporation began a series of actions to reduce the discharge of PCBs. PCB discharges were eliminated in 1977. In 1978, the exposed contaminated riverbank sediment deposits were stabilized, and one deposit was excavated. During 1977 and 1978, 200,000 cubic yards of contaminated sediment was dredged from the Hudson River near the PCB discharge point and placed in a clay-lined landfill. Remediation of seven contaminated landfill sites is almost complete.

The original remedial plan called for dredging 1.5 million cubic yards of sediment from a 40-mile segment of the upper river, removal of contaminated river bank deposits, and transfer of previously dredged sediment to a secure landfill with a capacity of 2.3

The original remedial plan called for dredging 1.5 million cubic yards of sediment from a 40-mile segment of the upper river, removal of contaminated river bank deposits, and transfer of previously dredged sediment to a secure landfill with a capacity of 2.3 million cubic yards. The cost of this plan was estimated to be $40 million. Due to increased costs of dredging and disposal [e.g., Resource Conservation and Recovery Act (RCRA)-approved landfill is now required] and the lack of additional funding sources, the original remedial plan has been pared down. There is a proposed project awaiting approval by the New York Hazardous Waste Siting Facility Board to dredge 380,000 cubic yards of the most highly contaminated sediment from a 5-mile segment of the river and place it in a landfill. Dredging under the proposed project is expected to start in 1990, and closure of the landfill is expected in 1991.

## SETTING PRIORITIES

1. **What factor prompted the initial focus on the site? Why was this site given priority over other potential sites in the region?**

From the discovery of PCB contamination problems in the early 1970s to the time of this writing, the major factor of concern about the site is fisheries contamination and related public health risks. Both the early discovery of this site and the extent of contamination contributed to its high priority for remediation.

2. **How were the magnitude and extent of the problem quantified (i.e., what factor drove the analysis of the problem)?**

Large-scale surveying and monitoring of PCBs in fish and sediment began in 1976 with funds from a settlement between the State of New York and General Electric.

3. **What factor drove the selection and implementation of remedial action?**

The high PCB concentrations in fish and the high (flow-dependent) rates of PCB transport to the Lower Hudson River drove the selection and implementation of remedial action for the river sediment.

4. **Were specific ranking methods applied to different phases of this project? Which methods were used?**

The discovery of PCBs in the Hudson River during the early 1970s predates widespread discovery and action on problems of hazardous substance contamination both in the State of New York and nationwide. Through the 1970s there was virtually no competition with other sites, as the State of New York charted its own course toward remediation. No ranking methods were applied to different phases of this project.

## CHOOSING ALTERNATIVES

1. **Who has formal responsibility for the scoping and final selection of the alternative?**

NYSDEC and the PCB Settlement Advisory Committee, a panel of scientists, engineers, environmental activists, and public representatives, shared the responsibility for the assessment of remedial options and the final selection of dredging and landfilling for sediment remediation.

**2. What major alternatives were considered?**

After completion of initial remediation in 1977 and 1978, dredging with upland disposal in a landfill (with and without treatment) was the major category of action considered. Within this framework, several alternatives were considered, ranging from no action to bank-to-bank dredging of the Upper Hudson River.

**3. What procedure was used to evaluate the alternatives (e.g., cost benefit analysis, evaluation criteria matrix)?**

Mathematical models of contaminated sediment transport and PCB bioaccumulation were used in combination with technical feasibility analyses and economic analyses to assess alternatives of sediment removal.

**4. What alternative was chosen? Was there an overriding regulatory or programmatic requirement that drove the choice of the alternative?**

The current alternative allows only for the removal of 380,000 cubic yards of contaminated river sediment. This alternative was derived from the original remedial plan. Due to funding constraints and litigation, this alternative is less comprehensive than original alternatives proposed for the site.

## IMPLEMENTING THE ALTERNATIVE

**1. What major legislative or regulatory constraints were encountered during the implementation of the chosen alternative?**

In 1979, Congress authorized $27 million for the Hudson River PCB Reclamation Project under the federal Clean Water Act. The project received all necessary state and federal permits in 1982. EPA endorsed the project in the Final Environmental Impact Statement but denied the release of Clean Water Act funds, citing the potential availability of Superfund remediation moneys. New York and several environmental groups sued EPA for the release of Clean Water Act funds. During this period, state permits for the proposed landfill were overturned in court based on pressure from project opponents. In 1984, a consent order was signed resolving the suit brought against EPA. However, by this time, the project was faced with 1) new regulations (i.e., RCRA) that drastically increased the cost of landfill construction, 2) the task of finding a new disposal site, and 3) a decision by EPA that Superfund would only address remediation of exposed river sediment (i.e., river banks).

**2. What regulations were most useful in pursuing action? How were funds obtained?**

Initially, the Clean Water Act was most useful for securing funds for site remediation. Funds were obtained via congressional and New York legislative appropriations.

**3. What mechanisms were established for communicating with local interests and the public? Did public perception of risks affect implementation of the project?**

Local interests and the public were directly involved in activities through a variety of mechanisms, including the PCB Settlement Advisory Committee. Public perception of risks associated with the proposed project were manifested in a successful legal challenge to an earlier version of the Project. Several methods of coping with risk perception and conflict of interest on the part of NYSDEC have been tried.

**4. How long did it take, or is it expected to take, to implement the alternative?**

Dredging under the proposed project is expected to start in 1990, and closure of the landfill is expected in 1991.

**5. What criteria were or will be used to measure the success of remediation?**

The goal for the current project is to achieve a 20 percent reduction in fish contamination in the Upper Hudson River and a 20 percent reduction in contaminated sediment transport to the Lower Hudson River. These goals will be compared to empirical data to determine the success of the project.

**6. How successful was the alternative in solving the problem identified during the setting of priorities?**

Remediation has not yet been implemented.

# CASE STUDY - MAY 1988
# NEW BEDFORD HARBOR SUPERFUND SITE

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## SITE BACKGROUND

**1. Where is the site located, how large is the site, and what are the major environmental problems and sources of contamination?**

The New Bedford Harbor site is located in southeast Massachusetts. The site consists of over 18,000 acres of sediments and includes the Acushnet River estuary and the harbor of the city of New Bedford. The sediment is contaminated with PCBs and heavy metals. Primary sources are allegedly two capacitor manufacturers in the area. There are also wastewater discharges in the vicinity. Since 1979, the area has been closed to all fishing and shellfishing. Development of the area has also been limited. The site was designated as the top priority site in the state of Massachusetts in 1982.

**2. Under what authority is this project being pursued?**

The project has been performed under the authority of the EPA Superfund program.

**3. What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?**

EPA has primary responsibility for the site. A number of other state and local agencies and organizations are involved in review and oversight, including the Massachusetts Department of Environmental Quality Engineering (DEQE), NOAA, the Department of Fish and Wildlife, the Massachusetts Office of Coastal Zone Management, and the Massachusetts Department of Health.

**4. What is the time-frame, current status, and approximate cost of the project?**

The remedial investigation has been completed. The feasibility study is in progress. It is expected that the Record of Decision will be finalized in June 1989.

| | |
|---|---|
| Cost of RI/FS Study: | $15-18 million (includes pilot study) |
| Cost of cleanup: | $20-800 million |

## SETTING PRIORITIES

**1. What factor prompted the initial focus on the site? Why was this site given priority over other potential sites in the region?**

Numerous studies in the early 1970s raised concerns about the site. The state requested EPA to include the site on the first Superfund list because of concern over human heath effects associated with seafood consumption and loss of the area's fisheries resources.

**2. How were the magnitude and extent of problem quantified (i.e., what factor drove the analysis of the problem)?**

The magnitude and extent of the problem were quantified by chemical analysis of sediments and fish tissues. No comprehensive human health effects study has been conducted. A preliminary survey of blood serum levels indicated that levels were elevated in only a few cases. The results of this study are the subject of debate.

**3. What factor drove the selection and implementation of remedial action?**

The original concern over the site was related to human health effects. However, the loss of the harbor as a resource may be an equally important factor driving future remedial action.

**4. Were specific ranking methods applied to different phases of this project? Which methods were used?**

The site did not score high enough to be included on the NPL using the initial NPL scoring criteria. The site was included on the NPL using the state's discretionary choice selection.

## CHOOSING ALTERNATIVES

**1. Who has formal responsibility for the scoping and final selection of the alternative?**

EPA has primary responsibility for the scoping and final selection of the alternative. DEQE has key involvement.

**2. What major alternatives are being considered?**

The following types of alternatives have been reviewed for possible application to the site:

- *In situ* capping (selected areas)
- Dredging-Disposal
- Dredging-Treatment-Disposal

Hydraulic dredging techniques that limit resuspension are considered the preferred removal technology. Potential disposal sites include confined upland, nearshore (lined and unlined), and open-water disposal sites. Potential treatment technologies include biodegradation, solvent extraction, supercritical fluid treatment, solidification, and dechlorination processes.

**3. What procedure was used to evaluate the alternatives (e.g., cost benefit analysis, evaluation criteria matrix)?**

An evaluation criteria matrix was used to evaluate alternatives and identify a preferred alternative. Criteria were based on EPA interim guidance contained in the Draft of Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (March 1988). Evaluation criteria include the following:

- Short-term Effectiveness
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, and Volume
- Implementability
- Cost
- Compliance with applicable or relevant and appropriate requirements (ARARs)
- Protection of Public Health and the Environment

**4. What alternative was chosen? Was there an overriding regulatory or programmatic requirement that drove the choice of the alternative?**

A remedial alternative has not yet been selected. Identification of a preferred alternative will be based on CERCLA guidance.

## IMPLEMENTING THE ALTERNATIVE

**1. What major legislative or regulatory constraints were encountered during the implementation of the chosen alternative?**

It is anticipated that two conflicting program goals will complicate selection of the preferred alternative. CERCLA guidance emphasizes alternatives that are conducted on site and that are permanent. Wetland legislation, RCRA, and water quality concerns emphasize solutions that do not impact wetlands.

**2. What regulations were most useful in pursuing action? How were funds obtained?**

The study and related actions are driven and funded by Superfund.

**3. What mechanisms were established for communicating with local interests and the public? Did public perception of risks affect implementation of the project?**

A Community Workgroup meets monthly. Participants represent business, fishermen, the health community, and potentially responsible parties (PRPs) from the city of New Bedford and three other local communities. Public perception of risk was more important at the beginning of the project. Concerns were somewhat allayed by the equivocal result of the health effects study. It is not anticipated that public perception of risk will affect implementation of the project.

**4. How long did it take, or is it expected to take, to implement the alternative?**

It is anticipated that it will take 2-10 years to implement the alternative, depending on the scope of the alternative selected.

**5. What criteria were or will be used to measure the success of remediation?**

Criteria that will be used to measure success have not been established. A three-dimensional hydrodynamic and food chain model will be used to predict compliance with ARARs. Water Quality Standards and FDA limits on the concentration of PCB in fish will probably be elements of the criteria.

**6. How successful was the alternative in solving the problem identified during the setting of priorities?**

The alternative has not yet been implemented.

## CASE STUDY - MAY 1988
## WAUKEGAN HARBOR SUPERFUND SITE

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### SITE BACKGROUND

1. **Where is the site located, how large is the site, and what are the major environmental problems and sources of contamination?**

The site occupies approximately 10 acres of Waukegan Harbor and portions of the Outboard Marine Corporation (OMC) property in Waukegan (Lake Michigan), Illinois. Sediments of the harbor are extensively contaminated with polychlorinated biphenyls (PCBs, at concentrations exceeding 10,000 mg/kg dry weight in some places) from chronic releases from OMC.

2. **Under what authority is this project being pursued?**

The Waukegan Harbor site is a federal Superfund site under EPA lead.

3. **What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?**

EPA has had prime responsibility for activities at the site since discovery of contamination in the early 1970s. Other key participants include the Corps, FWS, NOAA, Illinois EPA, Illinois Department of Conservation, and Illinois Department of Transportation.

4. **What is the time-frame, current status, and approximate cost of the project?**

Contamination of the site was first observed in the early 1970s. Several investigations have been completed since site discovery [including completion of the remedial investigation/feasibility study (RI/FS) process]. The total cost to date of studies, negotiations, and remedial design is approximately $1.5 million. A Record of Decision (ROD) was signed in May 1984 for cleanup costs of $21 million. The case has been in litigation since the signing of the ROD. EPA is currently negotiating a settlement with the PRP to initiate remediation. In March 1985, EPA revised cleanup estimates to $27 million based on preliminary remedial design. In OMC's 1986 annual report to taxpayers, the company listed $15 million in environmental liability, suggesting that estimated cleanup costs range from $15 to $27 million.

### SETTING PRIORITIES

1. **What factor prompted the initial focus on the site? Why was this site given priority over other potential sites in the region?**

This site was given high priority for action primarily for two reasons: 1) very high concentrations of PCBs were present in harbor sediments (in some places exceeding

10,000 mg/kg), and 2) there was a city of Waukegan emergency drinking water intake in the harbor.

**2. How were the magnitude and extent of the problem quantified (i.e., what factor drove the analysis of the problem)?**

PCB contamination of sediments in the harbor drove problem area definition. Data from several sediment surveys (surface sediments and sediment cores) defined the volume of contaminated material in the harbor. In addition to sediment surveys, surface water and fish have been sampled in the harbor, and soils and groundwater at the OMC facility have been sampled.

**3. What factor drove the selection and implementation of remedial action?**

The preferred alternative was selected primarily because of cost considerations for fund balancing. The alternative selected for maximum protection of human health and the environment had an estimated cost of $75 million. The preferred alternative is a modification of this alternative.

**4. Were specific ranking methods applied to different phases of this project? Which methods were used?**

No ranking methods were used during the course of this project. Hot spots were identified as areas with sediment PCB concentrations in excess of 10,000 mg/kg dry weight.

## CHOOSING ALTERNATIVES

**1. Who has formal responsibility for the scoping and final selection of the alternative?**

EPA and its contractor, FWS, and the Illinois EPA had prime responsibility for selecting the preferred alternative.

**2. What major alternatives were considered?**

Approximately 75 alternatives were considered for remediation in Waukegan Harbor. Alternatives were evaluated for *in situ* remediation, incineration, confinement in vaults, and various treatment technologies.

**3. What procedure was used to evaluate the alternatives (e.g., cost benefit analysis, evaluation criteria matrix)?**

Cost/benefit analysis (including consideration of human health and environmental impacts) was used to select the preferred alternative, with the final decision being driven by fund balancing. The area targeted for remediation was determined based on a combination of cost and environmental modeling. Modeling indicated that natural resources and human health would be acceptably protected with the removal of all sediment contaminated at levels at or above 100 mg/kg PCBs. Participating agencies applied a safety factor of 2 to this estimate, thus deciding to remediate all sediment contaminated with PCBs at concentrations at or above 50 mg/kg dry weight.

**4. What alternative was chosen? Was there an overriding regulatory or programmatic requirement that drove the choice of the alternative?**

*In situ* remediation was ruled infeasible early in the remedial evaluation process. The preferred alternative involves removal of sediment from hot spots, solidification, and disposal at a facility approved by TSCA; and removal of all other contaminated sediment (i.e, with PCBs ≥50 mg/kg) and confined disposal on OMC property. Disposal on OMC property will consist of construction of 1) slurry walls to the depth of glacial till hardpan, and 2) an impermeable cap over the disposal areas. Dredging undertaken as part of this project will be coordinated with dredging in the federal navigation channel by the Corps, with the net effect that all contaminated sediments (i.e., including those with <50 mg/kg PCBs) will be removed from the harbor. It is estimated that at the conclusion of remediation, more than 99 percent of the PCBs present in Waukegan Harbor will have been removed.

## IMPLEMENTING THE ALTERNATIVE

**1. What major legislative or regulatory constraints were encountered during the implementation of the chosen alternative?**

Remediation has not yet begun in Waukegan Harbor. The major constraint to remediation was posed by CERCLA, which allowed site access only for the purpose of engineering and investigation. CERCLA amendments under SARA removed this constraint by allowing for site access during remediation. There have been no constraints to the implementation of the dredging portion of site remediation.

**2. What regulations were most useful in pursuing action? How were funds obtained?**

Action was first pursued at this site under the federal CWA. Authority under the CWA was ill suited for addressing problems associated with Waukegan Harbor (i.e., contaminated sediment and the type of source and contaminant). Funding and the mechanisms for investigating and eventually remediating contamination at this site was offered through Superfund (especially SARA for the onsite portion of remediation) and TSCA.

**3. What mechanisms were established for communicating with local interests and the public? Did public perception of risks affect implementation of the project?**

Public involvement during the ROD process included distribution of fact sheets and several public meetings attended by area residents and citizen groups, the Sierra Club, and Lake Michigan environmental groups. Public perception of risk has not affected the project to date. Human health risks from this site were quantified during the course of study and were generally acceptable to public users.

**4. How long did it take, or is it expected to take, to implement the alternative?**

The alternative has not yet been implemented. Once implemented, it is expected to be complete in 2 years.

**5. What criteria were or will be used to measure the success of remediation?**

Specifications for the removal of sediment were determined based on the knowledge of the volume (areal extent and depth) of contaminated material. Performance specifications will be strictly adhered to during dredging. Soundings and some additional sediment sampling will be conducted after dredging is complete to ensure that the specified grade lines were achieved.

**6. How successful was the alternative in solving the problem identified during the setting of priorities?**

Remediation of contamination in Waukegan Harbor has not yet begun.

# CASE STUDY - MAY 1988
# DREDGED MATERIAL DISPOSAL MANAGEMENT PLAN FOR THE PORTS OF NEW YORK AND NEW JERSEY

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## THE SCOPE OF THE PLAN

**1. Define the planning area, and describe the major environmental problems and sources of contamination.**

The planning area includes the New York/New Jersey Harbor area and inner New York Bight. The planning area does not generally include upstate New York waters (e.g., upper Hudson River except for those sediments which are ocean-disposed). Sediment in the harbor areas are contaminated to varying degrees with a variety of chemicals, including mercury, cadmium, DDT, PCBs, and petroleum hydrocarbons. Major sources of contamination include permitted discharges, municipal wastewater including a significant volume of untreated sewage, agricultural runoff, PCBs from extensive contamination in the Upper Hudson River, urban runoff, and atmospheric deposition.

**2. Under what authority is this project being pursued?**

The project is being pursued under principal authority of the dredging program of the Corps. The project was initiated in part by a lawsuit filed by the National Wildlife Federation against the Corps to require the Corps to find alternatives to ocean disposal. Alternative analyses are also required under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (as amended).

**3. What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?**

A steering committee provides guidance on technical and institutional issues and is composed of representatives from the Corps, EPA, FWS, NOAA, New York State Department of Environmental Conservation (NYSDEC), New York State Department of State (responsible for Coastal Zone Management), and the New Jersey Department of Environmental Protection (NJDEP). The Public Involvement Coordination Group (PICG) also provides input to the plan and consists of environmental groups, community boards, labor, industry, elected officials, and state and local government agencies.

**4. What is the time-frame, current status, and approximate cost of the project?**

Development of the plan has been underway for 7 years (it was originally expected to take 5 years to complete) and some of the alternatives are currently in the early stages of implementation. The Corps has spent approximately $500,000 a year during plan development. A summary report is expected this year.

## SETTING PRIORITIES

### 1. How were key toxic sediment management problems identified?

There was knowledge of sediment contamination in the planning area long before the program was initiated. Sediment management problems were identified primarily because of two management needs: 1) the need to satisfy ocean disposal criteria, and 2) the need to investigate alternatives to ocean disposal.

### 2. How were the magnitude and extent of problems quantified (i.e., what factor drove the analysis of the problem)?

The magnitude and extent of contamination have been identified by a variety of mechanisms:

- Many historical studies by the Corps and others have surveyed sediment contamination and biological conditions in the study area
- Sediment chemistry and biological testing take place on a project-by-project basis to characterize the material requiring disposal
- Under the current planning effort, Corps has investigated physical, chemical, and biological characteristics of alternative aquatic disposal sites and site economics.

Problem quantification and planning were driven by the need to find cost-effective, environmentally acceptable disposal strategies for dredged material (both contaminated and uncontaminated). The principal contaminants of concern (Hg, Cd, petroleum hydrocarbons, PCBs, and DDT) were selected by consensus by the steering committee based on their possible occurrence in the planning area and potential adverse effects on marine biota.

### 3. What factors would affect the selection and implementation of remedial actions?

A combination of technical, cost, and institutional factors continue to affect the implementation of alternative disposal options. These are addressed by several questions below.

### 4. Were specific ranking methods applied to different phases of this project? Which methods?

Criteria were developed for each alternative studied. These criteria were used to screen the number of sites available for each option and to define the chemical and physical characteristics of acceptable dredged material. The primary ranking method used for disposal alternative decision-making consists of a combination of chemical analyses and biological testing. In general, dredged material is judged unsuitable for confined (i.e., capped) ocean disposal if:

- Bioaccumulation of many to most of the key contaminants listed above exceed "matrix values" and show statistically significant differences from reference sediment values (usually in more than one test organism). Matrix values are derived as concentrations of contaminants typical of a relatively clean (reference) area of the New York Bight or of the

New York/New Jersey Harbor.

- Mortality from bioassay tests exceed 10 percent difference between reference mortality values.
- The combination of bioassay (toxicity) and bioaccumulation testing as compared with a reference sediment is based on the concept of no further degradation.

Ranking was also used for evaluating the alternative disposal environments. Primary criteria used for these evaluations were cost, environmental protection, and ability to meet volume requirements of the program. For example, 500 upland disposal sites were identified at the beginning of the planning process. This number has since been reduced to 2 based on a number of factors, including transport costs and site size. Also, potential sites for containment islands were identified throughout the planning area. Sites were ranked based predominantly on habitat utilization (another major consideration was 20-foot minimum depth).

## CHOOSING ALTERNATIVES

**1. Who had formal responsibility for the scoping and final selection of the alternatives?**

The responsibility for scoping and selection of alternatives was shared by the Corps and all agencies in the steering committee.

**2. What major alternatives were considered?**

The major alternatives considered were continued ocean disposal and monitoring (at the Mud Dump site); ocean disposal with capping; small containment islands near or containment areas attached to land; large containment islands in the Lower and Upper Harbors; several upland disposal alternatives, including use of dredged material as cover material for sanitary landfills; subaqueous borrow pits in which former sand mining pits would be filled with contaminated dredged material and capped with clean material (digging new pits was also considered); wetlands stabilization; beach nourishment; and other beneficial uses.

**3. What procedure was used to evaluate the alternatives (e.g., cost benefit analysis, evaluation criteria matrix)?**

Several criteria were used to evaluate disposal alternatives. In general, decision-making was achieved by consensus building among members of the steering committee. Technical feasibility, potential environmental impact criteria, and cost were used in the evaluation process.

**4. What alternatives were chosen? Were there overriding regulatory or programmatic requirements that drove the choice of alternatives?**

The dredged material management plan consists of a mix of disposal scenarios. In general, ocean disposal is the only alternative for large volumes of dredged material. Capping can also be utilized when there is concern over potential environmental impacts.

Disposal and capping in subaqueous borrow pits, and construction of large (500 acres) containment islands also shows promise for long-term disposal of contaminated dredged material. The other options (upland disposal, use of dredged material as sanitary landfill cover, containment areas and islands, wetland stabilization areas) will be implemented when institutional and financial arrangements can be made. Finally, as a result of the plan studies, the New York Department of Sanitation is conducting a pilot study for potential use of dredged material as cover for the Fresh Kills landfill. Section 404 of the Clean Water Act and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (as amended) were the overriding programmatic and regulatory requirements driving selection of alternatives. Other regulatory and programmatic requirements influenced the planning process to a lesser degree. For example, initial planning involved consideration of very large (e.g., over 1,000 acres) containment islands for the disposal of all dredged material. Some agencies opposed this alternative because it would adversely impact a correspondingly large area of habitat utilized by marine resources. The present version of the containment island alternative (500 acres) is designed to accommodate the disposal of contaminated sediment only, for up to 20 years.

## IMPLEMENTING ALTERNATIVES

**1. What major alternative or regulatory constraints were encountered during implementation of alternatives?**

The major regulatory constraints encountered are generally those imposed by state regulatory agencies for non-ocean alternatives.

**2. What regulations were the most useful in pursuing action? How were funds obtained?**

Section 404 of the Clean Water Act and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (as amended) enable the Corps and EPA to regulate and plan for dredging and dredged material disposal in the New York/New Jersey planning area. Funding was appropriated for studies from the Corps Dredging Program.

**3. What mechanisms were established for communicating with local interests and the public? Is public perception of risks affecting implementation of the plan?**

A 500-member PICG provides input to the decision-making process by representing local government, environmental groups, community boards, labor, and industry. Seven vice-chairpersons of the group attend the Steering Committee meetings (held every six weeks) to provide input and report back to members at the PICG meetings (also held every six weeks). A newsletter, distributed to all interested parties before each meeting of the Steering Committee, contains general information about progress with the plan and related harbor activities. Public input has shaped decision-making throughout the planning process. For example, some members of the public were strongly opposed (to the point of suing the State of New York) to the use of the borrow pits for dredged material disposal on the grounds that this action would result in the loss of productive sport fishing grounds. A compromise may be reached whereby the creation of a new pit is agreed to by the former opponents of this option.

**4. How long did it take, or is it expected to take, to implement the plan?**

Planning has been underway since 1981. Capping was implemented as a management tool almost immediately with concurrent studies being performed on cap stability at the Mud Dump site. Implementation of certain aspects of the plan is now beginning. For example, disposal in borrow pits may begin soon, and sites have been identified for containment islands. Full or partial plan implementation rests on identifying local cooperating agencies who will work towards obtaining institutional and financial arrangements (e.g., for construction of containment islands, subaqueous borrow pits, containment areas/wetlands stabilization areas, beach nourishment, and upland disposal/use of dredged materials as sanitary landfill cover).

**5. What criteria were or will be used to measure the success of the plan?**

The primary goal of the plan was to identify feasible alternatives to ocean disposal of dredged material and to monitor and manage any of the disposal alternatives implemented; this goal has been met. This included a mud dump-site capping demonstration project by the Corps that proved that contaminated sediment could be disposed of in an ocean environment in an environmentally safe way (i.e., capping). This project involved the disposal of contaminated dredged material, capping of the contaminated material with clean sediment, and long-term monitoring for contaminant migration and cap integrity. Monitoring over a period of several years indicated that the cap was structurally intact (even after exposure to turbulence generated by a severe hurricane), and contaminants had not migrated into the surrounding environment.

**6. How successful were the alternatives in solving the problems identified during the setting of priorities?**

Technically feasible, cost effective alternatives were developed for large volumes of dredged material disposal in the New York/New Jersey Harbor area. Small containment islands, upland disposal sites, and wetlands stabilization were determined to be infeasible for regional dredged material disposal because they are unable to accommodate the large volumes of dredged material that require disposal. However, they may be possible in special cases or on a project-specific basis.

# CASE STUDY - MAY 1988
# SEDIMENT MANAGEMENT PLANS IN PUGET SOUND

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## THE SCOPE OF THE PLAN

### 1. Define the planning area, and describe the major environmental problems and sources of contamination.

The Washington Department of Ecology (Ecology), the Puget Sound Water Quality Authority (Authority), and EPA Region 10 have undertaken a comprehensive effort to establish sediment quality standards for use in Puget Sound. These standards, which will be promulgated through the Washington Administrative Code, will serve as the basis for regulatory decisions concerning the management, disposal, and remediation of contaminated sediments. The planning area currently encompasses Puget Sound, a large estuary in the state of Washington. Following development of sediment standards for the sound, marine and freshwater sediment quality standards will be developed for the rest of the state.

Puget Sound sediments contain a variety of chemical contaminants including heavy metals, PCBs, and several other organic chemicals. Contamination has resulted from a variety of point and nonpoint sources, including municipal and industrial discharges, combined sewer overflows and storm drains, and agricultural runoff.

### 2. Under what authority is this project being pursued?

This project is being pursued under the authority of the federal Water Quality Act of 1987, the Washington Water Pollution Control Act (Section 90.48 of the Revised Code of Washington), and the Authority (Section 90.70 of the Revised Code of Washington).

### 3. What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?

Ecology, the Authority, and EPA Region 10 have prime responsibility for the program. Other major participants include the Seattle District Corps, NOAA, and Washington Department of Natural Resources.

### 4. What is the time-frame, current status, and approximate cost of the project?

Efforts to develop sediment standards for use in Puget Sound were initiated in earnest 2 years ago. The first year was spent evaluating potential methods for setting standards, and the second year was spent refining and validating the method selected. Ecology intends to promulgate final standards by the following dates:

| | |
|---|---|
| ■ General Sediment Standards | Interim by 31 December 1988<br>Final by 30 June 1989 |
| ■ Effluent Particulate Limits | Interim by 30 June 1988<br>Final by 30 June 1989 |
| ■ Standard for Unconfined Disposal of Dredged Material | Interim by Summer 1988<br>Final by Summer 1989 |
| ■ Standard for Confined Disposal of Dredged Material | Interim by September 1989<br>Final by September 1990 |
| ■ Remedial Action Guidelines | Final by January 1991. |

## SETTING PRIORITIES

**1. How were key toxic sediment management problems identified?**

Combinations of the following four major approaches have been considered for identifying sediment management problems in Puget Sound: 1) a program focused on implementing best available technology to control environmental risks, 2) a sediment evaluation system based on controlling risks to human health, 3) an evaluation system based on comparison of chemistry values with reference areas values, and 4) an evaluation system based on the occurrence of biological effects.

For most programs (e.g., urban bays toxics action plans, dredged material disposal sites, and Superfund sites), management problems have been identified based on an evaluation of sediment contamination, observed and predicted biological effects, and human health risks associated with consumption of contaminated seafood. The significance of these evaluations has been determined relative to conditions at Puget Sound reference areas. Prioritization of problems has been reviewed by work groups or technical oversight committees composed of agency personnel, citizens and scientists from the community, and industrial representatives.

**2. How were the magnitude and extent of the problem quantified (i.e., what factor drove the analysis of the problem)?**

Surveys of Puget Sound by NOAA, EPA, and other agencies in the early 1980s documented the presence of abnormal benthic communities and high abundances of tumors in flatfish harvested in areas of high sediment contamination. Subsequent work has shown that sediment contamination in potentially toxic concentrations is widespread in many urban and industrial areas of the sound.

**3. What factors would affect the selection and implementation of remedial actions?**

Management options are always influenced by consideration of technological feasibility and cost prior to implementation. A variety of other factors may also influence selection and implementation of remedial actions, depending on the combination of approaches used for problem identification, and the particular goals of the subject program. For remedial actions, these factors include:

- The choice of action levels based on a range of available sediment quality values that can be used to predict volumes of contaminated sediments (lower action levels are protective of a wide range of potential biological effects; higher action levels focus attention on sites at which a preponderance of evidence predicts adverse biological effects)

- Optional or required site-specific biological testing to refine estimates based on these predictions

- The degree of contamination by ongoing vs. historical sources

- Consideration of the potential for natural recovery over an acceptable time period, and the status of source control actions.

A combination of chemical and biological guidelines has also been proposed for determining the suitability of open-water disposal for dredged material in Puget Sound. Dredged material containing chemicals at concentrations below a low chemical screening level would be suitable for open-water unconfined disposal without further testing. Biological testing would always be required to determine the suitability of material contaminated at concentrations between the screening level and a much higher maximum level. Contaminated material exceeding the maximum level would be assumed unsuitable for open-water unconfined disposal, although a battery of optional biological tests could be conducted to demonstrate that such material was suitable.

### 4. Were specific ranking methods applied to different phases of this project? Which methods?

Ranking methods differ based on project goals, and methods used for problem identification. In general, problems and remedial alternatives have been ranked using a matrix of independent indices. For example, problem areas are ranked in urban bay toxics programs based on an action assessment matrix. The matrix enables comparison of the elevation of chemical contamination and biological effects among problem areas relative to reference conditions. Biological indices include sediment toxicity (e.g., amphipod mortality and oyster larvae abnormality), and observed biological effects in the field (e.g., benthic infauna impacts, fish histopathological disorders, and bioaccumulation).

Following problem area ranking, additional methods are applied to focus resources on high priority actions. For example, at the Commencement Bay Superfund site, source control remedial alternatives have been ranked into three categories (high, medium, and low priority) by assigning a relative numerical value to three criteria for each source within a problem area, and to each problem area. The criteria include environmental significance (e.g., spatial extent and magnitude of sediment contamination attributable to each source), feasibility of source control (problem area-wide, and for individual sources), and status of ongoing source control efforts.

In combination with the proposed sediment standards, a ranking system will be recommended for application to a sound-wide inventory of contaminated sediments. The system will incorporate both environmental and human health concerns. Procedures will also be recommended for relating results of this ranking system to existing hazardous waste ranking systems that are primarily focused on land-based contamination and potential effects on human health.

## CHOOSING ALTERNATIVES

**1. Who had formal responsibility for the scoping and final selection of the alternatives?**

Although EPA was responsible for much of the work that went into the development and validation of approaches for identifying sediment contamination problems and evaluating alternative remedial measures, Ecology and the Authority are responsible for the scoping and final selection of state sediment quality standards. EPA will participate in a review capacity. The Washington Department of Natural Resources and the Corps were also partners in the development of strategies and standards for use in dredged material management.

**2. What major alternatives were considered?**

The four alternative "conditions" for site management evaluated for open-water dredged material disposal sites are representative of those considered for Puget Sound in general. These alternatives represent the relative severity of potential biological effects to be allowed at a site. Condition I would allow "no adverse effects" (i.e., no significant sublethal, chronic toxicity of any kind) at the site. Site Condition II would allow "minor adverse effects" (i.e., some chronic but no significant acute toxicity) at the site. Site Condition III would allow "moderate adverse effects" (but no severe acute toxicity) at the site. Site Condition IV would allow "major adverse effects" (but no dangerous waste defined by state regulations) at the site. Sediment management alternatives for other Puget Sound projects all involve establishing criteria that define the alternatives based on observed or potential biological effects and human health considerations.

**3. What procedure was used to evaluate the alternatives (e.g., cost benefit analysis, evaluation criteria matrix)?**

The methods for problem identification, remedial alternative evaluation, and selection of sediment management alternatives were evaluated based on one or more of the following procedures:

- Evaluation of the reliability of sediment quality values used to relate chemical concentrations and biological effects
- Review of evaluation criteria matrices of technical and cost factors for specific remedial actions
- Comparative analysis of environmental impacts associated with the sediment management alternatives
- Comparative cost analysis for implementing the different sediment management alternatives for specific programs.

**4. What alternatives were chosen? Were there overriding regulatory or programmatic requirements that drove the choice of the alternatives?**

Different sediment management alternatives have been or will be selected to meet the needs of different programs in Puget Sound, including the following:

- Dredged Material Disposal Guidelines: Guidelines have been proposed to establish "minor adverse effects" as the appropriate sediment management alternative for open-water disposal sites. Guidelines are being developed to establish appropriate alternatives for other disposal scenarios (e.g., open-water confined, nearshore, upland).

- Sound-wide Sediment Standards: Criteria are being proposed that support the "no adverse effects" alternative for designation of a sound-wide sediment inventory to be managed.

- Remedial Action Guidelines: The specific sediment management alternative for sound-wide remedial action is currently undecided. The thrust of this developing effort is to establish guidelines that will aid in decision-making, with possible use of a trigger-level criterion for requiring particular remedial actions such as *in situ* capping or removal and upland disposal or treatment. It is anticipated that the trigger-level will reflect effects-based sediment criteria that have been "cost-modified" for technical and economic feasibility.

- Effluent Permit Limits: The sound-wide sediment management alternative of "no adverse effects" will likely be integrated into effluent permit limits as a means of supporting the sound-wide goal over time through source control and natural burial of contaminated sediments.

## IMPLEMENTING ALTERNATIVES

**1. What major legislative or regulatory constraints were encountered during implementation of alternatives?**

No significant legislative or regulatory constraints were encountered during early development of the sediment quality standards.

**2. What regulations were most useful in pursuing action? How were funds obtained?**

Section 90.70 of the Revised Code of Washington, which provided the legislative authority for the creation of the Authority and the preparation of a Management Plan for Puget Sound, provided great impetus to Ecology for the development of state sediment standards. The 1987 Management Plan establishes specific goals for Puget Sound sediment quality and specific deadlines by which Ecology must promulgate standards.

**3. What mechanisms were established for communicating with local interests and the public? Is public perception of risks affecting implementation of the plan?**

Many of the early meetings in which the methods for developing sediment standards and consideration of sediment management alternatives were open to the regulated community. Public meetings, workshops, etc., have been and will continue to be used to communicate with local interests and the public at large. An EIS was prepared to evaluate potential ecological impacts associated with guidelines developed for dredged material disposal. Public advisory committee meetings and a "sediment advisory group" will provide direction for the development of state standards. Public perception of risks has affected the development of sediment standards in the sense that the public is demanding that the environmental quality of the sound be maintained and enhanced.

**4. How long did it take, or is it expected to take, to implement the plan?**

All standards, limits, and guidelines are scheduled to be developed by January 1991 (see Question 4 under **Scope of the Plan**).

**5. What criteria were or will be used to measure the success of the plan?**

A computerized database is being developed to store and track information on the extent and magnitude of sediment contamination and potentially associated biological effects (e.g., bioassay results, species abundances, histopathology, and bioaccumulation) in the sound. This database will be used in combination with sediment quality standards, a planned Puget Sound Monitoring Program, and project-related monitoring (e.g., remedial action monitoring at the Commencement Bay Superfund site) to: 1) evaluate the success of ongoing source control actions and sediment remedial actions, and 2) continue to reevaluate the reliability of sediment standards (periodic modification of the standards is expected).

**6. How successful were the alternatives in solving the problems identified during the setting of priorities?**

Criteria, standards, and limits are still under development.

## CASE STUDY - MAY 1988
## SULLIVAN'S LEDGE SUPERFUND SITE

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### SITE BACKGROUND

1. **Where is the site located, how large is the site, and what are the major environmental problems and sources of contamination?**

Sullivan's Ledge is located in New Bedford, Massachusetts. The most contaminated portion of the site is approximately 12 acres in size and includes a former rock quarry pit that was used by the city of New Bedford as an industrial disposal site. The entire study area is approximately 270 acres in size and includes wetlands north of the site.

There are three types of chemical contamination on the site: Contaminated soils, contaminated sediments, and contaminated groundwater. The deep bedrock aquifer underlying the pit is contaminated with volatile organic compounds. Groundwater contamination has also infiltrated into a stream adjacent to the site. PCB-contaminated soils in the vicinity of the disposal site have migrated offsite via runoff and contaminated stream sediments and wetlands north of the site.

2. **Under what authority is this project being pursued?**

The project has been performed under the authority of the EPA Superfund program.

3. **What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?**

EPA and the Massachusetts Department of Environmental Quality Engineering (DEQE) share primary responsibility for the site, with EPA as the lead agency. NOAA is also involved in review and oversight, primarily because of concerns over potential impacts to the Apponaganset Swamp, north of the site.

4. **What is the time-frame, current status, and approximate cost of the project?**

The Phase 1 remedial investigation was completed in December 1987, at a cost of approximately $700,000. The Phase 2 remedial investigation and feasibility study are scheduled for completion in July 1988, at a total cost of approximately $900,000. The Record of Decision will be completed by the end of 1988.

## SETTING PRIORITIES

1. **What factor prompted the initial focus on the site? Why was this site given priority over other potential sites in the region?**

In the early 1980s, the state wanted to build a parking lot on the site. Transformers and capacitors were unearthed during preliminary excavations. A site investigation was conducted immediately, and elevated levels of PCBs were found.

The site was not given priority over other sites in the region.

2. **How were the magnitude and extent of problem quantified (i.e., what factor drove the analysis of the problem)?**

The characterization of groundwater contamination was complex. The Phase 1 RI focused on the relationship between overburden and bedrock, and the groundwater flow regime. Additional deep bedrock wells were added during the Phase 2 RI to refine the characterization of groundwater contamination. The characterization of soil was complicated by offsite migration and by land use in the vicinity of the site. Stream water and stream and wetland sediments were analyzed to characterize offsite runoff.

3. **What factor drove the selection and implementation of remedial action?**

The selection and implementation of a preferred alternative will be driven by CERCLA guidelines and EPA directives.

4. **Were specific ranking methods applied to different phases of this project? Which methods were used?**

The hazardous waste site ranking system was applied to rank the site on the NPL. No other ranking system was applied to the site.

## CHOOSING ALTERNATIVES

1. **Who has formal responsibility for the scoping and final selection of the alternative?**

EPA and Massachusetts DEQE have formal responsibility for the scoping and final selection of the alternative.

2. **What major alternatives were considered?**

The following remedial alternatives are being considered for groundwater contamination:

- No action
- Containment (capping)
- Pump and treatment.

The following remedial alternatives are being considered for soil and sediment contamination:

- No action
- Containment
- Treatment (i.e., solidification, dechlorination, and incineration).

**3. What procedure was used to evaluate the alternatives (e.g., cost benefit analysis, evaluation criteria matrix)?**

An evaluation criteria matrix was used to evaluate alternatives and identify a preferred alternative. Criteria were based on the National Contingency Plan (NCP) and EPA interim guidance contained in the Draft of Guidance for Conducting RIs and FSs under CERCLA (March 1988). Evaluation criteria include the following:

- Effectiveness (compliance with ARARs)
- Implementability
- Cost.

**4. What alternative was chosen? Was there an overriding regulatory or programmatic requirement that drove the choice of the alternative?**

The preferred alternative has not yet been selected. It is anticipated that requirements of SARA (i.e., treatment alternatives that provide a permanent solution) will have a major influence on the selection of the alternative.

## IMPLEMENTING THE ALTERNATIVE

**1. What major legislative or regulatory constraints were encountered during the implementation of the chosen alternative?**

It is anticipated that the SARA waiver of ARARs may be invoked regarding groundwater treatment. Attainment of drinking water standards (MCL) using available pumping and treatment technologies may be technically infeasible.

**2. What regulations were most useful in pursuing action? How were funds obtained?**

SARA amendments were useful in that they were very specific regarding applicability of ARARs to remedial action implementation. The Winston Porter directives from headquarters helped to clarify EPA policy.

**3. What mechanisms were established for communicating with local interests and the public? Did public perception of risks affect implementation of the project?**

Until recently, there has not been active public involvement. Fact sheets have been sent to the public, and the first public meeting is scheduled for the end of May 1988. Public perception of risks has not affected the project thus far.

**4. How long did it take, or is it expected to take, to implement the alternative?**

The time it will take to implement the alternative depends on the alternative selected. Groundwater pumping and treatment could take from 10 to 20 years.

**5. What criteria were or will be used to measure the success of remediation?**

Performance standards will be identified for groundwater, and chemical concentrations will be monitored over time. Cleanup goals for contaminated soils will be based on human health risk assessments. Cleanup goals for contaminated sediments will be developed by relating water quality criteria to sediment concentrations using the concept of equilibrium partitioning.

**6. How successful was the alternative in solving the problem identified during the setting of priorities?**

The preferred alternative has not yet been selected or implemented.

## CASE STUDY - MAY 1988
## COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE

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*** Written case study provided as background information for participants; not presented at the workshop**

### SITE BACKGROUND

**1. Where is the site located, how large is the site, and what are the major environmental problems and sources of contamination?**

Commencement Bay is located in southern Puget Sound. Chemical contamination of the marine environment is the major problem at the site. The bay and tideflats are approximately 9 square miles and 12 square miles, respectively. However, the areal extent of sediments targeted for remedial action is less that 1 square mile. Commencement Bay supports important fisheries resources, especially anadromous salmonid populations. The site includes contaminated sediments in industrialized waterways and along the shoreline adjacent to a former copper smelter and upland sources of contamination.

Discharge and dumping of solid, liquid, organic, and inorganic waste material have contaminated waters and sediments in major portions of the site. There are 25 major identified sources supplying metals (arsenic, lead, zinc, mercury, copper) and organic contaminants (PCBs, chlorinated hydrocarbons, PAH compounds). Facilities that act as contaminant sources include a copper smelter, chemical and aluminum companies, lumber and pulp mills, petroleum storage facilities, ore unloading facilities, shipyards, plating facilities, marinas, and storm drains. Historically, raw sewage was discharged to the waterways. Over 400 potential sources of contaminants have been identified.

**2. Under what authority is this project being pursued?**

The investigation phase of the project has been performed under the authority of the EPA Superfund program. Enforcement and actions to reduce the ongoing release of contaminants have been pursued under a variety of state and federal environmental laws including the Washington State Water Pollution Control Act and the Hazardous Waste Cleanup Act.

**3. What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?**

Prime responsibility for the project is shared by EPA and the Washington State Department of Ecology (Ecology). Ecology was delegated the lead role in the investigation. A number of other federal, state, and local agencies and organizations are involved in review and oversight, including NOAA, the Washington Department of Fish and Wildlife, City of Tacoma, the Tacoma/Pierce County Health Department, the Washington Department of Natural Resources, Washington Department of Fisheries, the U.S. Geologic Survey, and the Puyallup Indian Nation. Ecology is the lead agency for the majority of enforcement actions designed to reduce the amount of contaminants being released to the marine environment.

**4. What is the time-frame, current status, and approximate cost of the project?**

The remedial investigation began in 1983 and was completed in 1985. The feasibility study will be completed in mid-1988. Source investigation and characterization has been developed, expanded, and refined over this period, and source controls have been implemented for some sources and are scheduled for the near future for others. It is anticipated that sediment remedial action will take place in phases from 1988 to 1996.

Total cost of the RI/FS: $3-$3.5 million
Costs associated with supplemental source characterization and source control: unknown
Estimated cost of sediment remedial action: $24-$64 million.

## SETTING PRIORITIES

**1. What factor prompted the initial focus on the site? Why was this site given priority over other potential sites in the region?**

In 1981, Commencement Bay was listed on the "interim priority list" of 115 sites targeted for Superfund action. Initial focus on the site was prompted by concerns over air emissions from ASARCO, groundwater contamination of the South Tacoma Channel, and investigations initiated by NOAA in 1978 that indicated that chemical contamination of the sediments could be associated with biological effects. Subsequently, the groundwater contamination in the South Tacoma Channel was addressed under a separate study. The Commencement Bay project consisted of two parts: chemical contamination of the upland environment near the ASARCO smelter, and chemical contamination and its effects in the marine environment.

**2. How were the magnitude and extent of the problem quantified (i.e., what factor drove the analysis of the problem)?**

The magnitude of sediment contamination was characterized using chemical analyses and biological effects indicators. Elevation of chemical concentration over reference area concentrations and the presence of measurable biological effects provided an indication of the magnitude of the problem. Areal extent of sediment contamination was characterized by collecting surface sediments from a number of locations in the waterways and along the shoreline. Vertical extent of sediment contamination was evaluated by collecting sediment cores and analyzing chemicals at various depth horizons.

**3. What factors drove the selection and implementation of remedial actions?**

The selection of preferred alternatives for the nine major problem areas in the study area is based on EPA interim guidance contained in the Preliminary Review Draft of Guidance for Conducting RIs and FSs under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (October 1987). Evaluation criteria included the following:

- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume
- Implementability
- Cost
- Compliance with ARARs
- Protection of public health and the environment.

The original concern over the site was related to environmental and human health effects. However, the economic limitations associated with the Superfund status of the site may be an equally important factor driving remedial action.

**4. Were specific ranking methods applied to different phases of this project? Which methods were used?**

Ranking schemes were applied to the project at a number of points during problem characterization. In general, ranking schemes assigned a numerical score to different criteria, and priority ranks were derived from total scores. Sediment cleanup goals based on the empirical relationship between biological effects and chemical concentrations [Apparent Effects Threshold (AET) values] were developed and included in ranking schemes at several phases of the project.

During the RI, ranking methods were applied to assign priority to:

Chemical contaminants (priority 1, 2, and 3)
Problem areas (high, medium, low).

During the FS, ranking methods were applied to assign priority to:

Additional source investigations
Chemicals requiring source control
Facilities requiring remedial action
Problem areas requiring remedial action.

## CHOOSING ALTERNATIVES

**1. Who has formal responsibility for the scoping and final selection of the alternative?**

Ecology and EPA have formal responsibility for scoping and final selection of the alternative.

**2. What major alternatives were considered?**

Remedial action at the site has two components: source control and sediment remedial action. The following sediment remedial alternatives were evaluated:

- *In situ* capping
- Dredge and confined disposal (upland, nearshore, and sub-aquatic)
- Dredge, treatment (solidification, incineration, biological, solvent extraction), and disposal (upland, nearshore, and sub-aquatic).

A large variety of sources exist on the site. Source control technologies considered for or applied to contaminated facilities include the following:

- Runoff controls (e.g., sedimentation basins)
- Soil capping
- Groundwater pump and treat
- Soil removal and/or treatment.

**3. What procedure was used to evaluate the alternative (e.g., cost benefit analysis, evaluation criteria matrix)?**

An evaluation criteria matrix was used to evaluate alternatives and identify a preferred alternative for each problem area. Criteria were based on EPA interim guidance contained in the Preliminary Review Draft of Guidance for Conducting RIs and FSs under CERCLA (October 1987).

**4. What alternative was chosen? Was there an overriding regulatory or programmatic requirement that drove the choice of the alternative?**

Preferred alternatives have not yet been selected. Availability of disposal sites has been the most difficult problem to overcome and has limited the feasibility of several potential disposal alternatives.

## IMPLEMENTING THE ALTERNATIVE

**1. What major legislative or regulatory constraints were encountered during the implementation of the chosen alternative?**

It is not anticipated that any major legislative or regulatory constraints will be encountered during implementation of the chosen alternative. Compliance with ARARs is a component of the evaluation process.

**2. What regulations were most useful in pursuing action? How were funds obtained?**

State and federal Superfund laws and the State Water Pollution Control Act have been the primary vehicles for pursuing action. Funding of remedial action by PRPs is the preferred option. However, state and federal Superfund monies are also available.

**3. What mechanisms were established for communicating with local interests and the public? Did public perception of risks affect implementation of the project?**

A Citizens Advisory Committee has been involved at key points throughout the RI/FS process. Fact sheets have been distributed at key project milestones. Similarly, public meetings and project briefings have been sponsored by Ecology and EPA. Public perception of risk has not been a driving force to date.

**4. How long did it take, or is it expected to take, to implement the alternative?**

It is anticipated that the preferred alternatives (including source control and sediment remedial actions) will be implemented in a phased manner between 1988 and 1996. Problem areas with the highest priority ranking will be implemented first to ensure that the worst environmental problems (and associated threat to public health) take precedence.

**5. What criteria were or will be used to measure the success of remediation?**

Both source loading and sediment concentrations will be monitored to ensure that cleanup goals are attained and maintained over the long term. Cleanup goals are based on AET. AET were developed during the RI to relate biological effects to chemical concentrations.

**6. How successful was the alternative in solving the problem identified during the setting of priorities?**

Not yet known.

# CASE STUDY - MAY 1988
# EVERETT HARBOR DREDGING PROJECT

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*** Written case study provided as background information for participants; not presented at the workshop**

## SITE BACKGROUND

**1. Where is the site located, how large is the site, and what are the major environmental problems and sources of contamination?**

The proposed dredging is to take place in support of the U.S. Navy Homeport project in Everett Harbor, Washington. Dredging of approximately 100,000 cubic yards of contaminated sediments will occur within the East Waterway of Everett Harbor, which occupies an area approximately 1200 meters long and 250 meters wide. The site is contaminated with a variety of chemicals, including 4-methylphenol, low molecular weight polycyclic aromatic hydrocarbons, resin acids (e.g., dehydroabietic acid), and to a lesser extent, several chlorinated phenols and guaiacols and PCBs. Potential sources of many of these contaminants include historical and present discharges from pulp and paper mills. In addition, ongoing surface runoff from storm drains is suspected to be contributing significant loadings of contaminants to the study area.

**2. Under what authority is this project being pursued?**

The planned dredging is in support of construction of a Navy Homeport for the aircraft carrier *Nimitz*, and is authorized under the National Defense Authorization Act (NDAA).

**3. What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?**

The U.S. Navy has prime responsibility over the project. Regulatory authority and oversight (e.g., planning and permitting) are provided by the following agencies: U.S. Navy, EPA, the Corps, FWS, NOAA, Washington Department of Ecology, and Washington State Departments of Natural Resources, Wildlife, and Fisheries. The city of Everett's role in shoreline planning (under the Federal Coastal Zone Management Act and State Shoreline Management Act) has increased since the inception of the project. Everett's involvement in the permitting process was recently assured by the 9th Circuit Court of Appeals in San Francisco, which ruled that the U.S. Navy was required to secure a Shoreline Substantial Development Permit from the city for (among other things) dredging activities.

**4. What is the time-frame, current status, and approximate cost of the project?**

It is expected that dredging and disposal can be completed within 24 months. However, disposal site monitoring may continue for an additional 10 years. The project is currently awaiting appropriation of funds from Congress. The project is estimated to cost in excess of $25.5 million. Testing and analysis of sediment in the East Waterway and at the disposal site is expected to cost in excess of $1 million; design, engineering, dredging, and disposal and capping of dredged material is expected to cost $17 million; and long-term monitoring is estimated to cost $7.5 million.

## SETTING PRIORITIES

1. **What factor prompted the initial focus on the site? Why was this site given priority over other potential sites in the region?**

This site was favored for citing a Navy Homeport over other sites in Puget Sound and the west coast of the United States for practical and strategic considerations.

2. **How were the magnitude and extent of the problem quantified (i.e., what factor drove the analysis of the problem)?**

The environmental problems and costs associated with the management of contaminated sediments prompted the characterization of the areal extent and depth of contamination and the determination of criteria for initially evaluating the sediment. The criteria selected were those already used at another dredged material disposal site in Puget Sound (Four-mile Rock near Seattle). Based on the results of the initial survey, additional chemical testing was recommended for the contaminated sediment, and biological testing was recommended for the cleaner sediment (i.e., sediment meeting the acceptability criteria for disposal at the Four-mile Rock site) and nearshore and open-water disposal sites.

3. **What factor drove the selection and implementation of remedial action?**

Selection of a remedial alternative was driven by the direct project needs (e.g., moorage for deep-draft vessels) and the evaluation of testing procedures for dredged material and disposal sites.

4. **Were specific ranking methods applied to different phases of this project? Which methods were used?**

Sediments were ranked in two classes based on chemical and physical characteristics. Chemical and biological testing requirements were developed for each class of sediment.

## CHOOSING ALTERNATIVES

1. **Who has formal responsibility for the scoping and final selection of the alternative?**

Responsibility for scoping and selection of an alternative was shared by the Navy, EPA, Corps, Washington Department of Natural Resources, Ecology, and the city of Everett.

**2. What major alternatives were considered?**

Three disposal options were considered: upland, nearshore, and confined aquatic.

**3. What procedure was used to evaluate the alternatives (e.g., cost benefit analysis, evaluation criteria matrix)?**

The options were evaluated based on chemical and biological testing requirements, design considerations, and cost. The EIS for the entire Homeport project presented an evaluation matrix for the three disposal options. The matrix contained several criteria that were together considered in the overall rating of each alternative.

**4. What alternative was chosen? Was there an overriding regulatory or programmatic requirement that drove the choice of the alternative?**

Confined aquatic disposal was chosen as the preferred alternative. There were no overriding regulatory or programmatic requirements driving this choice.

## IMPLEMENTING THE ALTERNATIVE

**1. What major legislative or regulatory constraints were encountered during the implementation of the chosen alternative?**

The major constraint encountered during selection of the preferred alternative is that state regulations do not provide clear guidance for decision-making involving the management of contaminated sediment. State guidance is much more clear if sediment is treated as an aquatic discharge under the federal CWA (e.g., state programs associated with Section 404 for dredging and Section 401 for water quality certification) than if it is treated as solid waste (e.g., upland disposal). If dredged material is treated as solid waste, state regulations give management authority to local health departments, and it is unclear whether a federal facility would be required to meet local regulations.

**2. What regulations were most useful in pursuing action? How were funds obtained?**

Section 401 of the federal CWA (state water quality certification) was the most useful regulation for pursuing action during this project. Under Section 401, state agencies have the authority to issue water quality certifications for federal projects where there are potential water quality impacts. Ecology has the additional authority to issue water quality modifications for permitting temporary violations of ambient water quality criteria (e.g., during dredging and/or disposal operations). Both regulatory tools are useful because regulatory compliance can be conditioned on a variety of factors. For example, the water quality certification issued to the Navy for this project included pass/fail performance standards for the capping operation. These standards will allow Ecology to temporarily or permanently halt disposal activities if a number of circumstances arise (e.g., inaccurate placement of cap material or excessive migration of contaminants). In addition, a comprehensive monitoring program is included as a condition of the water quality certification and allows Ecology to require a variety of actions if unacceptable adverse impacts are detected after the disposal is complete.

**3. What mechanisms were established for communicating with local interests and the public? Did public perception of risks affect implementation of the project?**

Several public involvement and participation mechanisms have been used during the course of this project, including 1) scoping, hearings, and public information meetings that were conducted as part of the federal and state EIS processes; 2) public hearings that were a part of the 401 Certification process; and 3) public hearings by the state legislature. Public perception of risks and concern over potential environmental impacts primarily affected the project by increasing the emphasis on biological impacts during dredging and disposal and after cap placement. For example, monitoring of the sea surface microlayer was incorporated into the water quality certification to address public concerns.

**4. How long did it take, or is it expected to take, to implement the alternative?**

Dredging and placement of dredged and cap material is expected to take 2 years. Long-term monitoring may occur over an additional 10-year period.

**5. What criteria were or will be used to measure the success of remediation?**

A comprehensive, long-term monitoring program has been designed to determine whether contaminants from the disposal site are adversely affecting marine biota. Monitoring includes testing for the migration of contaminants, migration of contaminated sediment, bioaccumulation, benthic impacts, and water quality impacts. The monitoring program is designed to phase out some components over time if results indicate a low probability of impacts. Additional long-term monitoring is required at the dredging site to ensure that sediments do not become recontaminated.

**6. How successful was the alternative in solving the problem identified during the setting of priorities?**

The alternative has not been implemented.

## CASE STUDY - MAY 1988
## PORT OF OAKLAND DREDGING PROJECT

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*** Written case study provided as background information for participants; not presented at the workshop**

### SITE BACKGROUND

**1. Where is the site located, how large is the site, and what are the major environmental problems and sources of contamination?**

The Port of Oakland is located in San Francisco Bay adjacent to the city of Oakland. The Port of Oakland determined that dredging was needed to allow access to larger vessels and to expand the economic capabilities of the port.

Heavy metals, PAH, and tributyltin are present at elevated concentrations in some of the sediments designated to be dredged. The contamination is attributed to shipyards and heavy industry situated near the harbor.

Dredging is to be conducted in two phases. In Phase 1, the inner harbor will be dredged from its current depth of -35 feet to -38 feet. This will involve the removal of approximately 560,000 cubic yards of sediment. In Phase 2, the inner and outer harbors will be dredged to -42 feet. This will involve the movement of approximately 7,000,000 cubic yards of sediments.

**2. Under what authority is this project being pursued?**

The Port of Oakland project is being pursued under Section 103 of the Ocean Dumping Act.

**3. What federal, state, and local agencies have either prime responsibility for the project or provide review and oversight? Did this involvement change over the course of the project?**

Prime responsibility for the project is shared by federal Corps and EPA, state (California Regional Water Quality Control Board and San Francisco Bay Conservation and Development Commission), and local (Port of Oakland) agencies and organizations.

Project review also involves other federal (Fish and Wildlife Department, National Marine Fisheries) and state agencies (California Fish and Game Department).

Involvement has not changed over the course of the project.

4. **What is the time-frame, current status, and approximate cost of the project?**

Phase 1 dredging is expected to begin in May 1988 and last approximately 1.5 months. Phase 2 dredging is expected to begin in September 1988 and last approximately 18 months. It was originally thought that all of the dredged material (Phase 1 and Phase 2) could be disposed of at an open-water unconfined site, at a total cost of $30-$50 million. It has been determined that the more severely contaminated sediments must be disposed of at upland facilities. The added costs associated with the option have not been determined.

Harbor sediments have been sampled for physical, biological, and chemical characterization on three separate occasions. The cost of the first two studies is not known. The cost of the third is estimated to be between $300,000 and $400,000.

## SETTING PRIORITIES

1. **What factor prompted the initial focus on the site? Why was this site given priority over other potential sites in the region?**

The Port of Oakland and the Corps determined that the port should be dredged to expand economic capabilities and make it more competitive with other west coast ports.

2. **How were the magnitude and extent of the problem quantified (i.e., what factor drove the analysis of the problem)?**

There were concerns that sediments to be dredged were contaminated and that the process of dredging and disposal could threaten human health and the environment.

Physical, chemical, and biological properties of the sediments were characterized to define the extent of sediment contamination. Physical characterization included grain size, density, and plasticity of the sediments. Chemical characterization included conventional analyses and a reduced list (approximately 60 chemicals) of EPA priority pollutants. Biological characterization included toxicity and bioaccumulation testing.

3. **What factor drove the selection and implementation of remedial action?**

Ocean dumping regulations do not allow toxic sediments to be dumped in the open ocean (40 CFR 227).

4. **Were specific ranking methods applied to different phases of this project? Which methods were used?**

The relative toxicity of sediments was ranked on the basis of the toxic response of biological indicators, the relative magnitude of chemical concentrations, and by comparison with other sites.

## CHOOSING ALTERNATIVES

**1. Who has formal responsibility for the scoping and final selection of the alternative?**

The Corps evaluates applications and authorizations for dredged material permits under Section 103 of the Ocean Dumping Act (40 CFR Part 225.1). The Regional Administrator of EPA receives specific permit information from the Corps (40 CFR Part 225.2(a)] and makes an independent evaluation of the proposed dumping [40 CFR Part 225.2(c)]. As a result of this independent evaluation, the Regional Administrator determines whether the proposed action complies with the requirements of the Ocean Dumping Act [40 CFR Part 225.2(d) and (e)]. If the material does not comply, the District Engineer ma;y not issue a permit unless: 1) a determination is accepted by the Chief of Engineers that no economically feasible alternatives exist, and 2) a waiver of EPA's criteria is sought from the EPA Administrator. The Administrator has 30 days to act on the Chief of Engineer's request (40 CFR Part 225.4). If upland disposal is chosen over other open-water or nearshore alternatives, the state of California is responsible for selection of the disposal alternative.

**2. What major alternatives were considered?**

The following removal/disposal option were considered:

- Unconfined ocean dumping (in bay, out of bay, off the continental shelf)
- Upland disposal.

Treatment alternatives were not considered.

**3. What procedure was used to evaluate the alternatives (e.g., cost benefit analysis, evaluation criteria matrix)?**

Neither approach was used to evaluate the alternatives. Alternatives were selected on the basis of ocean dumping regulations (40 CFR 220-229) and the EPA/Corps Implementation Manual for Ocean Dumping (1977).

**4. What alternative was chosen? Was there an overriding regulatory or programmatic requirement that drove the choice of the alternative?**

Phase 1 dredged material that is suitable for open ocean dumping will be dumped at a site 24 miles south of the bay, near the Golden Gate ship canal. Neither the upland disposal alternative nor the open ocean dumpsite for Phase 2 material has been selected.

## IMPLEMENTING THE ALTERNATIVE

**1. What major legislative or regulatory constraints were encountered during the implementation of the chosen alternative?**

No major legislative or regulatory constraints were encountered; however, litigation has become an issue. Fishermen from Half Moon Bay have filed a lawsuit against the Port of Oakland and Corps to block dumping at the selected disposal site.

**2. What regulations were most useful in pursuing action? How were funds obtained?**

Ocean dumping regulations and NEPA regulations are the most pertinent to the disposal site. Section 401 of the federal CWA and Section 307c of the Coastal Zone Management Act are applicable at dredging locations. The Port of Oakland will pay for 25 percent of the total project cost and the Corps will pay for 75 percent.

**3. What mechanisms were established for communicating with local interests and the public? Did public perception of risks affect implementation of the project?**

A Dredged Material steering Committee includes representatives from local, federal, and state agencies and the public. Public views were also presented during the public comment period and during public hearings. Public perception of risks played a major role in the selection process.

**4. How long did it take, or is it expected to take, to implement the alternative?**

Phase 1 dredging is expected to begin in May 1988 and last approximately 1.5 months.
Phase 2 dredging is expected to begin in September 1988 and last approximately 18 months.
Monitoring of the dump site after dumping will be conducted for 1 year.

**5. What criteria were or will be used to measure the success of remediation?**

The goal of the project is not remediation but the environmentally protective implementation of dredging for economic purposes. No formal criteria exist; however, monitoring of the dump site will be conducted and will probably involve measurement of the same parameters used to characterize the sediment before dredging.

**6. How successful was the alternative in solving the problem identified during the setting of priorities?**

The alternative has not yet been implemented.

# APPENDIX C

# OVERVIEW OF MAJOR LAWS AND REGULATIONS CONCERNING THE MANAGEMENT OF CONTAMINATED SEDIMENTS

# MAJOR POTENTIAL FACILITATING AND CONSTRAINING ASPECTS OF SELECTED ENVIRONMENTAL LAWS AND REGULATIONS RELATING TO SEDIMENT REMEDIAL ACTION

The following discussion provides a summary of general relationships between major environmental laws (and associated regulations) and four major sediment remedial action/cleanup activities:

- Problem Identification: Includes activities such as environmental surveys (e.g., sediment chemistry, benthic infauna effects, and bioaccumulation), human health risk assessment, and programs to determine suitable action or cleanup levels (i.e., sediment criteria).

- Sediment Removal: Refers to activities (nearshore or open-water) associated with dredging or excavation of contaminated sediment.

- Sediment Disposal: Includes the transportation and disposal of contaminated sediment in a variety of environments and under a number of conditions, for example:

    - Upland, nearshore intertidal, nearshore subtidal, or open-water environments

    - Unconfined (i.e., material deposited is not isolated from the surrounding environment) and confined (e.g., excavation/disposal, dikes, capping, or landfilling) conditions.

- Habitat Restoration: Includes a variety of activities in upland, nearshore and open-water environments. Activities can range from creation of intertidal habitat (e.g., salt marsh) to restoration of open-water disposal area to natural conditions (e.g., matching of slope and native material).

Brief summaries of major environmental laws and regulations relevant to sediment remedial action are presented in Table C-1. General relationships between laws and regulations and major activities of sediment remediation are illustrated in Figure 1. The remainder of this paper provides brief explanations of the relationships depicted in Figure 1, and presents a summary evaluation of the major constraints of existing environmental laws and regulations (in terms of implementing sediment remediation) and potential mitigating measures.

## CLEAN WATER ACT (AS AMENDED BY THE WATER QUALITY ACT OF 1987)

The Water Quality Act of 1987 and its precursors (e.g., Federal Water Pollution Control Act Amendments of 1972-1980) establish a number of programs designed to restore and maintain the physical, chemical, and biological integrity of the Nation's waters.

## TABLE C-1. EXAMPLES OF MAJOR ENVIRONMENTAL LAWS AND REGULATIONS RELEVANT TO SEDIMENT REMEDIAL ACTIONS

| Law | Purpose |
|---|---|
| Clean Water Act as amended by the Water Quality Act of 1987 (CWA) | Establishes authority to restore and maintain the chemical, physical, and biological integrity of the nation's waters. |
| Section 104 | Establishes national programs for the prevention, reduction, and elimination of pollution through research, experiments, and demonstrations. |
| Section 105 | Establishes a grant system for research and development projects on contaminant sources. |
| Section 108 | Establishes demonstration projects for mitigating pollution in the Great Lakes. |
| Section 115 | Provides authority to identify the location of in-place pollutants with emphasis on toxic pollutants in harbors and navigable waterways. |
| Section 117 | Provides for continuation of the Chesapeake Bay program. |
| Section 118 | Requires annual reports on the status of pollutants in sediments of the Great Lakes, and establishment of a 5-year study and demonstration project for the removal of sediments with toxic pollutants. |
| Section 304(a) | Authorizes development and publication of criteria reflecting the scientific knowledge on the environmental effects of pollutants. |
| Section 314 | Establishes a Clean Lakes Program and water quality demonstration programs. |
| Section 401 | Requires state water quality certification for any project that may result in the violation of a state water quality standard. |
| Section 404 | Establishes permits for discharge of dredged or fill material into navigable waters of the U.S. |

TABLE C-1. (Continued)

| Law | Purpose |
|---|---|
| Marine Protection, Research, and Sanctuaries Act (MPRSA) | Provides authority to regulate the transportation for dumping and the dumping of material into ocean waters. |
| Section 102 | Authorizes dumping permits for sewage sludge and industrial wastes. |
| Section 103 | Authorizes permits for the transportation of dredged material for the purpose of dumping into ocean waters. |
| Coastal Zone Management Act (CZMA) | Establishes a framework and matching grants for states to develop and implement a Coastal Zone Management Plan. Local governments develop Shoreline Master Programs in participating states. |
| Superfund Amendments and Reauthorization Act (SARA) | SARA amends the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) on a number of programmatic and enforcement/judicial issues, and establishes new programs and funding levels. The new provisions include the requirement to evaluate all facilities on CERCLIS (as of date of enactment) with HRS within 4 years of enactment; this provision may have the effect of altering the present ranking of sites. CERCLA establishes a fund and comprehensive program for identifying, investigating, and remediating hazardous waste sites and recovering costs from responsible parties. |
| Resource Conservation and Recovery Act (RCRA) | Authorizes efforts to promote the protection of human health and the environment and to conserve valuable material and energy resources by regulating the treatment, storage, and transportation of hazardous wastes that have adverse effects on health and the environment. Includes provisions and guidance for establishing and permitting solid waste disposal facilities. |
| Toxic Substances Control Act (TSCA) | Authorizes regulation of chemical substances and mixtures that present an unreasonable risk of injury to health and the environment (especially PCBs and dioxin). Authorizes development of testing methods including toxicity testing, and development of priority list under Section 4(a). |
| National Environmental Policy Act (NEPA) | Requires the preparation of an Environmental Impact Statement (EIS) for projects deemed to cause significant adverse impacts. |

TABLE C-1. (Continued)

| Law | Purpose |
|---|---|
| Regulations for Hazardous Materials Transport | Establishes requirements and restrictions for the transportation of hazardous materials on federal highways. |
| Occupational Safety and Health Act (OSHA) | Establishes safety requirements for workers in the workplace, including maximum exposure times and concentrations for numerous hazardous substances. |
| National Ocean Program Act (NOPA) | Confers authority to coordinate pollution programs among the federal agencies involved in marine research, monitoring, and regulations. |
| Floodplain Management | Establishes requirements and procedures for projects in floodplains. |
| Wetlands Protection | Establishes requirements and procedures for projects in wetlands. |

FIGURE C-1. FACILITATING AND CONSTRAINING ASPECTS OF SELECTED ENVIRONMENTAL LAWS AND REGULATIONS RELATED TO SEDIMENT REMEDIAL ACTION

| Section 304(a) | Problem Identification |  | Sediment Removal |  | Sediment Disposal |  | Habitat Restoration |  |
|---|---|---|---|---|---|---|---|---|
|  | Facilitating | Constraining | Facilitating | Constraining | Facilitating | Constraining | Facilitating | Constraining |
| CWA |  |  |  |  |  |  |  |  |
| Section 104 | 💵 |  | 💵 |  | 💵 |  |  |  |
| Section 105 | 💵 🏢 |  |  |  | 💵 🏢 |  |  |  |
| Section 108 | 💵 🏢 ✋ | 🗺 | 💵 🏢 ✋ | 🗺 | 💵 🏢 ✋ | 🗺 |  |  |
| Section 115 |  |  | 💵 🏢 ✋ |  |  |  |  |  |
| Section 117 | 💵 🏢 ✋ | 🗺 |  |  |  |  |  |  |
| Section 118 | 💵 🏢 ✋ | 🗺 | ✋ | 🗺 |  |  |  |  |
| Section 304(a) | 💵 🏢 ✋ |  |  |  |  |  |  |  |
| Section 314 | 💵 🏢 ✋ | 🗺 | 💵 🏢 ✋ | 🗺 | 💵 🏢 ✋ | 🗺 | 💵 🏢 ✋ | 🗺 |
| Section 401 |  |  | ✋ | ⚗ 🏗 | ✋ | ⚗ 🏗 🗺 | ✋ | ⚗ |
| Section 404 | 🏢 |  | 🏢 | ⚗ 🏗 |  | ⚗ 🗺 | 💵 🏢 ✋ |  |
| MPRSA |  |  |  |  |  |  |  |  |
| Section 102 |  |  |  |  | 🏢 ✋ | ⚗ 🗺 |  |  |
| Section 103 |  |  | 🏢 ✋ | 🏗 🗺 | 🏢 ✋ | ⚗ 🗺 |  |  |
| CZMA |  |  |  |  | ✋ | 🗺 | ✋ |  |
| SARA | 💵 🏢 ✋ | ⚗ | 💵 🏢 ✋ | ⚗ 🏗 🗺 | 💵 🏢 ✋ | 🗺 | 💵 🏢 ✋ |  |
| RCRA | 💵 🏢 ✋ |  | 💵 🏢 ✋ | 🏗 | 💵 🏢 ✋ | ⚗ 🏗 🗺 | 💵 🏢 ✋ |  |
| TSCA | 💵 🏢 ✋ |  | 🏢 ✋ | 🏗 🗺 | 🏢 ✋ | 🏗 🗺 |  |  |
| NEPA |  |  |  | ⚗ 🏗 🗺 |  | ⚗ 🏗 🗺 | 🏢 ✋ |  |
| Regulations for Hazardous Materials Transportation |  |  |  | ⚗ 🏗 |  | ⚗ 🏗 |  |  |
| OSHA |  | ⚗ 🏗 🗺 |  | ⚗ 🏗 🗺 |  | ⚗ 🏗 🗺 |  |  |
| OPA | 💵 🏢 ✋ |  | 💵 🏢 ✋ |  | 💵 🏢 ✋ |  | ✋ |  |
| Floodplain Management |  |  |  |  |  | 🏗 🗺 |  | 🏗 🗺 |
| Wetlands Protection |  |  |  |  |  | 🏗 🗺 | 🏢 ✋ | 🏗 🗺 |
| Local Land Use Ordinances |  |  |  |  | ✋ | 🗺 | ✋ | 🗺 |

💵 = Funding support.
🏢 = Administrative support.
✋ = Action/land use planning support.
⚗ = Chemical limits.
🏗 = Design/construction limitations.
🗺 = Site availability constraints.

**Section 104**

Section 104 establishes national programs of research, investigations, experiments, training, and information exchange for the prevention, reduction, and elimination of pollution. Activities under this section can primarily facilitate problem identification and sediment removal and disposal by providing funding support for investigations that can contribute to the state of knowledge about fate and effects of contaminated sediment.

**Section 105**

Section 105 establishes a grant system for research and development projects, including projects on advanced waste treatment methods for contaminant sources. Demonstration projects include investigations of in place or accumulated sources and methods for confining these sources or otherwise preventing the migration of pollutants into the environment. Funding support for facilitating the development of techniques for sediment removal or disposal (e.g., confined disposal) is also potentially provided under this section.

**Section 108**

Section 108 establishes demonstration projects for mitigating pollution in the Great Lakes. Section 108(d)(2) delegates responsibility to the Corps to develop a demonstration waste water management program for Lake Erie. This program should include measures to control sources including in place sources, bottom loads, sludge banks, and polluted harbor dredgings.

Significant support to programs in Lake Erie may be provided under Section 108 for the identification of problem areas, sediment removal and disposal, and habitat restoration. However, the program is constrained to Lake Erie only.

**Section 115**

Section 115 of the Water Quality Act of 1987 provides EPA with authority to identify the location of contaminated sediments and (in cooperation with the Army Corps of Engineers) take action for sediment removal. The emphasis of the program is on sediments in harbors and navigable waters that are contaminated with toxic pollutants. Section 115 primarily influences sediment remedial actions by providing funding, administrative, and planning support for problem identification. As the program develops, it may also provide funding, administrative, and planing support for the removal of contaminated sediments.

**Section 117**

Section 117 of the Clean Water Act of 1987 provides for the continuation of the Chesapeake Bay program. To the extent that the program focuses on contaminated sediment, it can provide support in the form of funding, program administration, and planning, primarily relative to problem identification. Sediment removal and disposal actions may also be facilitated by the program, but are not specifically called out in the Act. Habitat restoration may be facilitated by the program to the extent that removal of contaminated sediment takes place.

### Section 118

Section 118 of the Water Quality Act of 1987 establishes the Great Lakes National Program Office and assigns it a variety of responsibilities, including: yearly reporting of environmental conditions, comprehensive monitoring, interagency and international coordination, and establishment of programs for reducing point and non-point sources of contaminants and conducting 5-year demonstration projects for identifying and remediating contaminated sediments. Six areas are identified as priorities for demonstration project implementation.

Section 118 can potentially facilitate problem identification and sediment removal by providing support through demonstration projects in the form of funding, administrative support, and planning support. Similarly, the Great Lakes program can facilitate habitat restoration by the removal of contaminated sediment.

By potentially limiting the development of demonstration projects to priority areas identified in the Act, Section 118 may constrain problem identification, sediment removal, and habitat restoration in other potentially contaminated areas.

### Section 304(a)

Section 304(a) delegates responsibility to EPA for developing water quality criteria based on the latest scientific knowledge about biological effects of pollutants at the individual and community level, and the environmental concentration and dispersal of pollutants. Sections 301(a)(7) and 301(a)(8) were added by the Water Quality Act of 1987 and specify technical assistance to states on how to develop and measure water quality criteria.

Section 304(a) primarily facilitates problem identification through the furthering of knowledge about pollutant fate and effects.

### Section 314

Section 314 establishes a Clean Lakes program to identify contamination problems in lakes, identify sources of pollution, and investigate and implement mitigation measures. Section 314(d) requires EPA to establish and conduct a Lake Water Quality Demonstration Program, including programs to demonstrate environmentally preferred techniques for the removal and disposal of contaminated sediments, and demonstrate the costs and benefits of using dredged material for land reclamation.

Section 314 facilitates the identification of problem sediments, development of techniques for sediment removal and disposal, and habitat restoration, by providing support in the form of funding, program administration, and planning. Sediment remedial support under Section 314 is limited to lakes.

### Section 401

Section 401 requires State Water Quality Certification for any project that may cause the violation of a state water quality standard. Section 401 may offer action planning support for sediment removal and disposal activities and habitat restoration activities by offering a degree of predictability to the planning process (i.e., *a priori* documentation of limitations that may be imposed on a project). Section 401 constraints will be manifested primarily as limitations on design and construction (for sediment removal and disposal) and site availability (for sediment disposal). The severity of these constraints will probably tend to increase with an increase in the likelihood that state water quality standards may be violated. Sediment removal and disposal and habitat restoration activities may be precluded if they are deemed to result in significant violations of state water quality standards (determined by the state on a case-by-case basis).

### Section 404

Section 404 of the Clean Water Act of 1977 provides authority to the Corps to issue permits for the discharge of dredged or fill material and designation of disposal sites in navigable waters of the United States (including nearshore fill sites). EPA provides an important role in the process by assisting the Corps in developing guidelines for disposal and material testing. In addition, EPA may prohibit the disposal of some materials under certain conditions, and is responsible for determining areas that can be used for disposal sites. Section 404 regulations include:

- Criteria for compliance with guidelines for dredged material disposal
- Guidelines for the evaluation and testing of dredged material
- Specifications for actions to minimize adverse effects
- Requirements for obtaining state water quality certification for the disposal of dredged material.

Section 404 programs have the potential to contribute administrative support to problem identification via requirements for testing sediment. To the extent that contaminated sediment has been identified for removal during a dredging project (e.g., maintenance of navigational channels or new construction), Section 404 may also provide administrative support to sediment removal efforts. For example, at the Commencement Bay Superfund site, planned maintenance and construction dredging will be coordinated with sediment removal in order to maximize the efficiency of remedial actions.

Section 404 guidelines and regulations may constrain sediment disposal options by precluding the disposal of sediment at certain sites or under certain conditions (e.g., because of elevated contaminant concentrations or other factors). Wetland protection policies and regulations of the Corps can facilitate habitat restoration to the extent that mitigative measures are incorporated into 404 permits. Mitigative measures may include habitat creation or restoration, or in-kind replacement (i.e., purchase of wetland habitat for placement into public trust).

## MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT (MPRSA OR OCEAN DUMPING ACT)

The MPRSA provides authority to regulate the transportation of material for ocean dumping, ocean dumping activities, and the designation and maintenance of ocean disposal sites.

### Section 102

Section 102 establishes a permit system for the ocean disposal of sewage sludge and industrial waste, and the designation and maintenance of disposal sites. The disposal permit regulations establish criteria for evaluating permit applications. Environmental impact criteria include evaluation procedures, prohibited constituents, and limitations on the disposal of specific wastes. Disposal site management criteria include procedures for designating sites, evaluating impacts, monitoring disposal practices, and conducting baseline surveys. Section 102 can facilitate sediment remediation primarily through the designation of potential disposal sites. However, requirements for testing and approving materials may pose constraints on disposal in some cases.

### Section 103

Section 103 authorizes EPA review of Corps permits for the transport and disposal of dredged material, including review of site designation rationale if a proposed site is not a designated site under MPRSA. Administrative and planning support for the removal and disposal of contaminated sediment (e.g., by providing alternative disposal sites) may be provided under Section 103; however it may pose constraints to disposal under some conditions because of limitations on chemical constituents and site availability.

## COASTAL ZONE MANAGEMENT ACT (CZMA)

The CZMA establishes a national support program for states to develop and implement a Coastal Zone Management Program. Based on the state program, local governments (e.g., counties and cities) prepare and implement Shoreline Management Plans (SMP). The jurisdiction of SMP are highly variable but usually encompass activities within several hundred feet of the shoreline (e.g., including nearshore dredging and disposal), and sometimes include state waters (e.g., open-water dredging and disposal). The CZMA, via local SMP, may facilitate sediment disposal by providing planning support (e.g., providing guidance on where and under what conditions these activities will be allowed). For the same reasons, SMP may also constrain sediment disposal (i.e., by limiting siting possibilities). One of the objectives of the CZMA is to foster habitat protection and may thus facilitate implementation of remediation that results in habitat restoration.

## SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA)

SARA amends the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). CERCLA/SARA establishes a fund and comprehensive program for identifying, investigating, and remediating problems at hazardous waste sites. SARA can have a profound impact on contaminated sediment remediation at relevant designated superfund sites. The primary objective of CERCLA/SARA is to effectively reduce or eliminate risks to human health and the environment from hazardous substances. At Superfund sites, CERCLA/SARA outlines a detailed process for characterizing the extent and nature of contamination, evaluating remedial alternatives, and performing remediation.

SARA can potentially provide support for all sediment remediation activities in the form of funding, administrative support, and planning. Problem identification can be facilitated during the site discovery (e.g., Preliminary Assessment/Site Investigation) and remedial investigation phases of the SARA process. Other facilitating aspects of

SARA are applicable only at sites on the National Priorities List (NPL). At these sites, sediment removal can be facilitated during site remediation. Sediment that is removed may be disposed of on- or off-site, with or without treatment. Sediment disposal may be facilitated by providing alternative disposal sites (e.g., contaminated sediment may be confined in-situ [capping], disposed of in nearshore or upland portions of a site, or transferred off-site for disposal). Habitat restoration is generally facilitated to the extent that sediment remediation improves environmental quality. In addition, SARA authorizes federal and state resource management agencies to file natural resource damage claims against responsible parties at Superfund sites (43 CFR Part 11). Pursuant to federal regulations for natural resource damage assessments (NRDA), moneys recovered for damages must be used for resource (e.g., habitat) restoration or replacement.

Problem identification under SARA is not limited to Superfund sites, but would be limited to sites at which SARA hazardous wastes are present (or suspected to be present). Sediment removal, sediment disposal, and habitat restoration under SARA are all limited to Superfund sites.

## RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

A major feature of RCRA is the establishment of programs for regulating the treatment, storage, and disposal of hazardous waste. Under RCRA, a large number of guidance documents and standards have been developed, including design and operation requirements for landfills and treatment facilities (e.g., land treatment and incinerators).

RCRA can potentially facilitate all aspects of sediment remedial action via funding, administrative, and planning support.

As a constraint to sediment remediation, RCRA would only be applicable at facilities with (or eligible for) a RCRA permit where site activities have contributed to the contamination of sediments. In addition, RCRA may pose some constraints in the form of remedial or construction design for sediment removal and disposal.

## TOXIC SUBSTANCES CONTROL ACT (TSCA)

TSCA provides that EPA establish a committee for developing regulations for the testing, manufacture, processing, and distribution of toxic chemicals. Detailed requirements and guidelines are specified for the handling and disposal of materials containing PCBs and dioxins. TSCA can potentially provide support to problem identification and sediment removal and disposal actions via development of evaluation and test methods, and technologies for handling and disposing of toxic materials. TSCA requirements for toxic chemical handling and disposal may pose constraints to sediment removal and disposal actions in certain cases (e.g., treatment requirements for materials containing PCBs).

## NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

NEPA generally requires the preparation of an Environmental Impact Statement for federal projects for which significant environmental impacts are expected. NEPA poses potential constraints to sediment removal and disposal activities insofar as these activities may result in environmental impacts. NEPA may affect remedial design and implementation by requiring mitigative measures for chemical contaminant levels, remedial design and construction limitations, and selection of a disposal site. Sediment remedial actions will generally comply with NEPA as long as they result in a decrease in environmental impacts. Mitigative measures possibly required by NEPA may also have the effect of facilitating habitat restoration (i.e., in addition to the restorative effects of sediment removal).

## REGULATIONS FOR HAZARDOUS MATERIAL TRANSPORTATION

Federal rules for the transportation of hazardous materials may pose minor constraints to the removal and disposal of contaminated sediment in terms of chemical concentration limitations, and design and construction limitations. Constraints will most likely involve procedural, equipment, and design requirements during the transportation of contaminated sediment on federal highways.

## OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

The primary function of OSHA is to establish safety requirements for workers in the work place, including maximum permissible exposure limits for numerous hazardous substances. OSHA may pose minor constraints to problem identification, and sediment removal and disposal activities insofar as workers may be exposed to hazardous substances on the job. Constraints will most likely consist of requirements for ensuring worker safety (e.g., approved health and safety training and health and safety plan, and use of safety equipment).

## NATIONAL OCEAN PROGRAM ACT (NOPA)

NOPA requires coordination among federal agencies involved in marine research and monitoring and the promulgation of regulations. Relatively limited funding, administrative, and planning support for problem identification, and sediment removal and disposal actions is expected under NOPA. The support offered under NOPA will be directly related to the benefits of coordination that may accrue to certain programs (e.g., RCRA hazardous material treatment pilot studies may be applicable to contaminated sediment remediation).

## FLOODPLAIN MANAGEMENT

Federal floodplain management regulations establish a variety of requirements for projects in floodplains and are expected to pose minor constraints relative to project design and construction. These regulations may prevent disposal of contaminated sediment in a floodplain.

## WETLANDS PROTECTION

Federal wetlands protection regulations establish requirements for projects in wetlands and are expected to pose minor constraints to sediment disposal relative to design and construction. These regulations may prevent disposal of contaminated sediment in wetlands. Wetlands protection regulations may provide planning and administrative support for projects resulting in wetland restoration.

## SUMMARY

Federal regulations can influence sediment remedial activities in a variety of ways. In general, activities may be constrained in terms of: 1) activity type (e.g., dredging, disposal, and treatment), 2) location of activity (e.g., disposal upland, nearshore, deep water, or offshore), and 3) chemical contamination (e.g., constraints will vary depending on nature and extent of contamination). All laws and regulations affecting sediment remedial activities are designed for the protection of the environment and/or human health. After a cursory inspection, it does not appear that the enforcement of these regulations (alone or in combination) would prevent implementation on any feasible sediment remedial alternative (assuming the alternative results in a reduction or elimination of environmental or human health risk). However, each law emphasizes different aspects of environmental or human health protection, and in some cases the design or implementation of sediment remedial alternatives may be significantly affected. For example constraints for a project involving dredging of severely contaminated sediment (e.g., classifiable as RCRA hazardous waste) from a wetland and disposal in open water might include:

- For Dredging Activities:
    - Preparation of an EIS (if the dredging location is not on a Superfund site)
    - Satisfaction of Water Quality Act Section 404 permit requirements for dredged material testing and agency review (e.g., may include implementation of mitigating measures for potential impacts to fish and wildlife)
    - Compliance with local land use ordinances (e.g., pursuant to CZMA)
- For Sediment Disposal Activities [i.e., assuming material is a RCRA hazardous waste and can only be disposed of (untreated) in a RCRA approved disposal facility]:
    - Satisfaction of requirements for a variety of treatment alternatives (e.g., incineration, solidification, and land treatment) under RCRA
    - Satisfaction of a variety of requirements depending on location and design of disposal site, and remaining chemical contamination levels
    - Compliance with local land use ordinances (e.g., pursuant to CZMA)
    - Compliance with specific material handling requirements of transportation regulations (e.g., regulations for the transportation of material on federal highways and water-borne transport pursuant to MPRSA).
- For Habitat Restoration Activities: Satisfaction of interagency review and approval (and possible design constraints) pursuant to Water Quality Act (WQA) Section 404 permit, wetland protection regulations, and local ordinances (e.g., pursuant to CZMA).

Existing environmental laws and regulations govern virtually all major aspects (i.e., related to specific actions, locations, or chemical concentrations) of sediment remedial activities. It appears that most potential constraints are related to inefficiencies caused by regulatory and administrative duplication of effort, or conflicting specifications of laws and regulations. In most cases where there is a problem of conflicting specifications (e.g., different chemical concentration requirements for different media such as surface water and groundwater, or differences between state and federal requirements), the conflict can be resolved by adopting or enforcing the stricter (or strictest) requirement. The nature and severity of such constraints is likely to vary depending on project-specific characteristics. Evaluation of the need for new laws or regulations for sediment remedial activities should take into account the following three factors:

1) Potential creation of additional regulatory overlap or conflict (with existing laws and regulations) which may outweigh the benefits of increased predictability

2) The likely ongoing need for project-by-project evaluation of regulatory constraints (i.e., will additional laws/regulations improve predictability?)

3) Existing provisions for inter-agency and inter-program review and coordination may allow for the development of administrative mechanisms, eliminating the need for new laws and regulations.

Implementation of sediment remedial programs may benefit substantially from the creation or modification of administrative mechanisms for fostering coordination and cooperation among key agencies (e.g., Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration). It may be beneficial to implement strategies for enhanced coordination and cooperation (e.g., development of consistent policy, procedures and criteria for multi-agency evaluation of sediment remedial activities) at both the national level and the state-regional level, specially since sediment remedial program needs will vary among EPA regions and among states.

This evaluation was performed based on a cursory review of major environmental laws and regulations, and conclusions should be interpreted only in very general terms. A more detailed review of laws, regulations and programs, and interviews with key agency personnel in EPA regions would enable: 1) identification of major conflicts among existing laws, regulations, and national programs; 2) description of the general characteristics of sediment remedial programs in EPA regions; and 3) specification of potential mitigating measures for resolving constraints.

# APPENDIX D

## OVERVIEW OF NATIONAL ACADEMY MARINE BOARD WORKSHOP ON CONTAMINATED SEDIMENTS

### Strategies and Technologies for Cleaning Up and Managing Contaminated Marine Sediments

Tampa, Florida
May 30 - June 3, 1988

## SUMMARY OF COMMITTEE CHARGE

**OBJECTIVE** Appraise strategies and technologies for cleaning up and managing contaminated marine sediments.

**PRODUCT** A report, including workshop proceedings and a supplemental committee analysis, describing technical and programmatic issues concerning cleanup, and management of contaminated marine sediments.

The report will provide an **improved understanding** of contaminated sediment **on which to base decisions** concerning management and technical research and development. It will **include recommendations** to the Corps of Engineers, the Environmental Protection Agency, states, and industry regarding further study and technical development.

## SUMMARY OF PROJECT SCOPE

(see detailed description at end of this appendix)

**PROJECT ELEMENTS:**

- Determine extent and significance of contamination
- Review the state-of-the-art of technology for cleanup and remediation
- Identify and appraise alternative management strategies
- Identify R&D needs and issues for subsequent technical assessment

## COMMITTEE MEMBERSHIP

**Kenneth S. Kamlet**, Chairman, A.T. Kearney, Inc.

- Contaminated sediment and marine pollution law and policy

**William J. Adams**, Monsanto Company

- Aquatic toxicology, alternative biological waste treatment technologies

**A. Karim Ahmed**, Natural Resources Defense Council, Inc.

- Toxicology, public health risk assessment

**Henry J. Bokuniewicz**, State University of New York at Stony Brook

- Sediment transport and deposition, subaqueous capping

**Thomas A. Grigalunas**, University of Rhode Island

- Natural resource economics

**John B. Herbich**, Texas A&M University

- Dredging technology, coastal and ocean engineering

**Robert J. Huggett**, Virginia Institute of Marine Science

- Fate and effects of toxic chemicals in aquatic systems

**Howard L. Sanders**, Woods Hole Oceanographic Institution

- Benthic ecology

**James M. Thornton**, State of Washington Department of Ecology

- Contaminated sediment policy and planning

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### U.S. CONGRESS

James Evans, Office of Rep. Mike Lowery

# STRATEGIES AND TECHNOLOGIES FOR CLEANING UP AND MANAGING CONTAMINATED MARINE SEDIMENTS

## SUMMARY

Contamination of marine sediments poses a potential threat to marine resources, including the food chain. Improving the nation's capability to clean up and manage contaminated sediments is critical to the health of the marine environment as well as to the utilization of the nation's waterways for navigation and commerce. EPA has identified 1,500 high-priority hazardous waste sites, of which NOAA has noted at least 95 that may threaten marine resources (excluding the Great Lakes). Whereas the cleanup of hazardous wastes is a concern of EPA, states, and regulated industries, the problem of handling contaminated marine sediments in navigation channels and harbors (that need to be dredged) falls primarily to the Corps.

Contaminated marine sediments can be left alone, removed by dredging and managed offsite; or confined, capped, or stabilized in place. Efforts to address the unique technical and engineering problems associated with "cleaning up" (or otherwise remediating) hazardous waste and contaminated sediment at underwater sites have, unfortunately, received very limited attention.

As a result of discussions with the Corps' Dredging Division and the EPA Offices of Water, Emergency and Remedial Response (Superfund), and ORD, the Marine Board proposes to appraise strategies and technologies for cleaning up and managing contaminated marine sediments. A committee would be appointed to convene a workshop that will examine the extent of contamination and its significance, review the state of practice of technology for cleanup and remediation, identify and appraise alternate management strategies, and identify research and development needs and issues for subsequent technical assessment. The committee would prepare a report that includes the proceedings of the workshop and a summary appraisal that describes technical and programmatic issues concerning cleaning up and managing contaminated marine sediments and makes recommendations to the Corps and EPA regarding further study and technical development.

## BACKGROUND

EPA's Office of Water, several EPA regional offices, and the Corps are interested from different perspectives in problems associated with contaminated marine sediments. The EPA's interest relates to water quality concerns and its mandate to remediate uncontrolled hazardous waste (Superfund) sites. The Corps is involved and concerned because of its responsibility to dredge and maintain navigable rivers and harbors. In addition, under an agreement with EPA, the Corps assists in the design and implementation of remedial cleanup actions under Superfund.

The Clean Water Act, as amended by the Water Quality Act of 1987, gives EPA lead responsibility for safeguarding the quality of U.S. coastal and inland waters. This includes regulating the disposal of dredged and fill materials (shared with the Corps under Section 404), and removing in-place toxic pollutants in harbors and navigable waterways (under Section 115). The 1987 amendments added new authorities requiring EPA to study and conduct projects relating to the removal of toxic pollutants from Great

Lakes marine sediments [Section 118(c)(3)]; to identify and implement individual control strategies to reduce toxic pollutant inputs into contaminated waterway segments [Section 304(l)]; and to formalize a National Estuary Program aimed at identifying and protecting nationally significant estuaries (Section 320). The EPA Office of Water is also pursuing initiatives to implement a broad-based Nearshore Coastal Strategy and to develop sediment quality criteria to address water quality problems attributable to contamination of marine sediments.

In addition to the Clean Water Act, which is directed at protecting water quality, CERCLA, as amended by SARA, is aimed at the cleanup and remediation of inactive or abandoned hazardous waste sites, regardless of location. At least two National Priorities List Superfund sites involve cleanup of contaminated marine sediments: New Bedford Harbor, Massachusetts and Commencement Bay, Puget Sound, Washington. Several others involve submerged freshwater sites within the Great Lakes Basin. NOAA has identified close to 100 coastal (non-Great Lakes) Superfund sites with the potential to threaten marine resources.

Superfund sites are currently ranked by EPA based on the hazard they may pose to human health and the environment via releases to groundwater, surface water, and air. Underwater accumulations of hazardous waste, particularly in marine environments, are unlikely to threaten human health except by way of food-chain exposure, which is not currently addressed in EPA's hazard ranking process. Under the 1986 Superfund amendments, however, EPA was required to modify its hazard ranking system to address "the damage to natural resources which may affect the human food chain and which is associated with any release or threatened release (of a hazardous substance" [Section 105(a)(2)]. It is likely, therefore, once this amendment is implemented, that there will be a significant increase in the number of underwater Superfund sites in both coastal and inland areas.

To date, contaminated marine sediments have been managed on an ad hoc, site-specific basis. As a result, cleanup efforts have not necessarily employed the most cost-effective or technologically advanced methods available. Contaminated marine sediments can be dealt with in one of three ways, depending upon circumstances:

- They can be left alone (as was done for kepone-contaminated sediments in the James River, Virginia)
- They can be removed by dredging and managed offsite (as is proposed for PCB-contaminated sediments in the upper Hudson River, New York)
- They can be confined, capped, or stabilized in place.

Dredging can involve several different types of equipment (i.e., mechanical, pneumatic, and/or hydraulic dredges), with or without silt curtains to minimize the dispersal of disturbed sediment, each subject to particular depth limitations, precision capabilities, turbidity-resuspension tendencies, and sediment consolidation capabilities. The appropriateness of a particular dredge type or dredging technique will also depend on the properties of the sediment contaminants to be removed, particularly their degree of water solubility and their volatility. There are also many issues associated with the ultimate disposition of dredged sediments.

## PROPOSED PLAN OF ACTION

A committee of about seven members will be established under the Marine Board with expertise in state, federal, and industrial cleanup of hazardous wastes; sediment dynamics and transport; environmental science; dredging technology; natural resource damage assessment; risk assessment and economic impact; and public interest in coastal protection. The committee will convene a workshop with invited papers in order to:

- Determine the extent of contamination and its significance
- Review the state of practice of technology for cleanup and remediation
- Identify and appraise alternate management strategies (including removal of sediments by dredging for management offsite; confining, capping, or stabilizing sediments in place; and no remedial action coupled with regulation of activities at or near the site)
- Identify research and development needs and issues for subsequent technical assessment.

(Such findings would address classification of sediments and the extent of contamination; cleanup/remediation technologies including dredging technologies; and sediment, environmental, and waterway management strategies).

The workshop will provide a forum for examining and discussing current developments. It will focus on the special technical problems and engineering issues associated with mitigating the environmental impacts of contaminant accumulation in marine sediments. The committee will solicit participation in the workshop by individuals from many backgrounds: federal and state regulatory authorities, dredging technology; Superfund cleanup contracting, natural resource damage assessment, environmental, and industry interest; and scientific research.

## ANTICIPATED RESULTS

The committee will prepare a report that includes the proceedings of the workshop and a summary appraisal by the committee that describes technical and programmatic issues concerning cleaning up and managing contaminated marine sediments and makes recommendations to the Corps and EPA regarding further study and technical development. The report will provide an improved understanding of contaminated marine sediments on which to base decisions concerning management as well as technical research and development to enhance the national capability to address and resolve the problem of contaminated marine sediments.